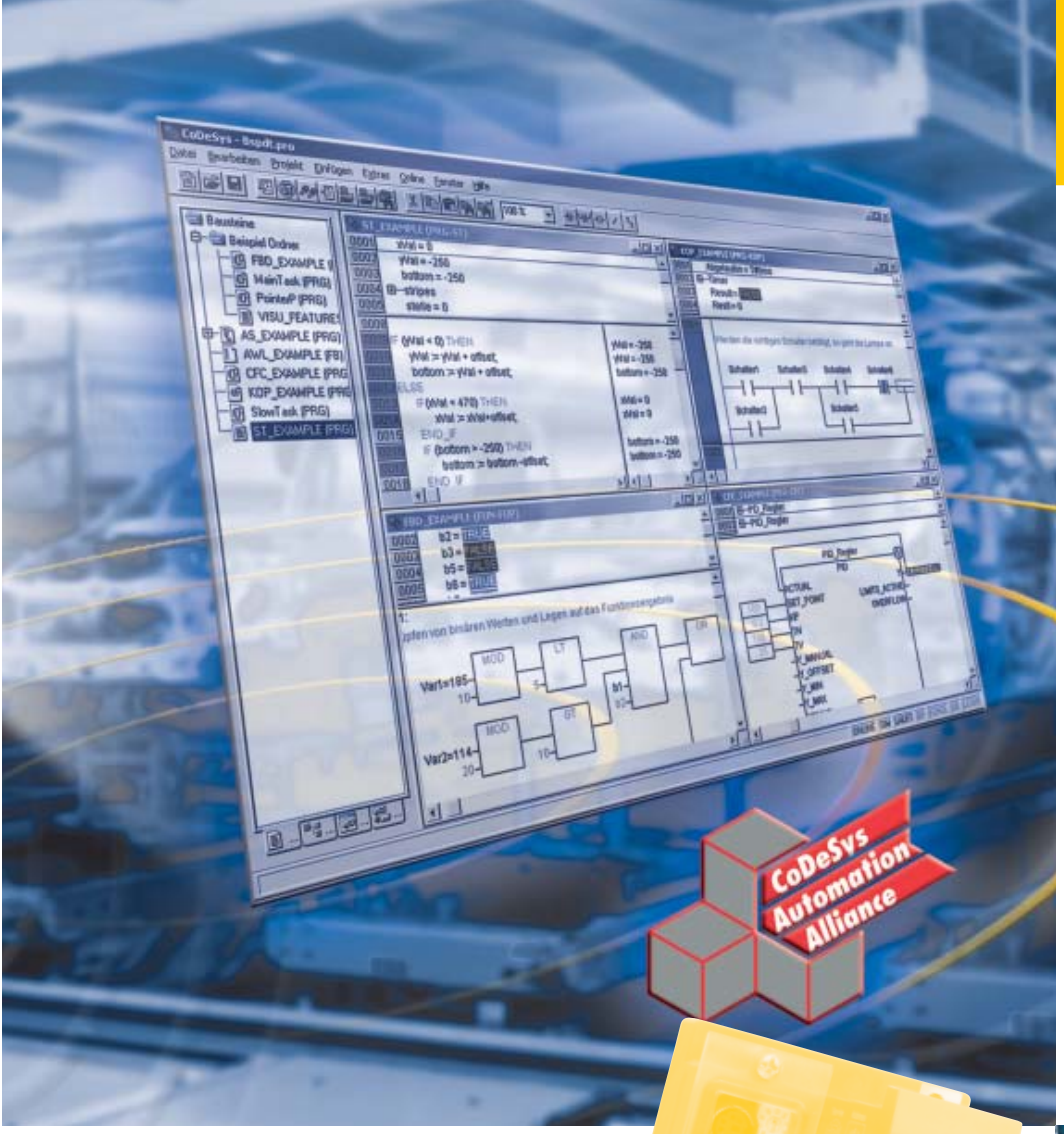
TURCK

Industrial
Automation

BL20 –

USER MANUAL FOR BL20-PG-EN



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Edition 12/11

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Subject to alterations without notice

Before starting the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighboring units that are live.
- Follow the engineering instructions (AWA) of the device concerned.
- Only suitably qualified personnel in accordance with EN 50 110-1/-2 (VDE 0 105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalization. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60 364-4-41 (VDE 0 100 Part 410) or HD 384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60 204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).
- The electrical installation must be carried out in accordance with the relevant regulations (e. g. with regard to cable cross sections, fuses, PE).
- All work relating to transport, installation, commissioning and maintenance must only be carried out by qualified personnel. (IEC 60 364 and HD 384 and national work safety regulations).
- All shrouds and doors must be kept closed during operation.

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1.1 Documentation Concept

This manual contains information about the programmable BL20 Modbus TCP gateway BL20-PG-EN.

The following chapters contain a short BL20 system description, a description of the field bus system Ethernet, exact information about function and structure of the BL20 Ethernet gateways as well as all bus specific information concerning the connection to automation devices, the maximum system extension etc.

The bus-independent I/O-modules for BL20 as well as all further fieldbus-independent chapters like mounting, labelling etc. are described in a separate manual.

- BL20 I/O-modules (TURCK-Documentation-No.: German D300716/ English D300717)

Furthermore, the manual mentioned above contains a short description of the project planning and diagnostics software for TURCK I/O-systems, the engineering software I/O-ASSISTANT.

1.2 Description of Symbols Used

Danger

This sign can be found next to all notes that indicate a source of hazards. This can refer to danger to personnel or damage to the system (hardware and software) and to the facility.

This sign means for the operator: work with extreme caution.

Attention

This sign can be found next to all notes that indicate a potential hazard.

This can refer to possible danger to personnel and damages to the system (hardware and software) and to the facility.

Note

This sign can be found next to all general notes that supply important information about one or more operating steps. These specific notes are intended to make operation easier and avoid unnecessary work due to incorrect operation.

1.3 General Information

Attention

Please read this section carefully. Safety aspects cannot be left to chance when dealing with electrical equipment.

This manual contains all necessary information about the prescibed use of the programmable TURCK gateway BL20-PG-EN.
It has been specially conceived for personnel with the necessary qualifications.

1.3.1 Prescribed Use

Danger

The devices described in this manual must be used only in applications prescribed in this manual or in the respective technical descriptions, and only with certified components and devices from third party manufacturers.

Appropriate transport, storage, deployment and mounting as well as careful operating and thorough maintenance guarantee the trouble-free and safe operation of these devices.

1.3.2 Notes Concerning Planning /Installation of this Product

Danger

All respective safety measures and accident protection guidelines must be considered carefully and without exception.

1.4 List of Revisions

In comparison to the previous manual edition, the following changes/ revisions have been made:

Table 1-1: List of revisions

Chapter	Subject/ Description	new	changed/ updated
4	Address-setting via I/O-ASSISTANT 3 (FDT/DTM) (page 4-15)		X
5	Modbus Registers (page 5-2)		X
	Data Width of the I/O-Modules in the Modbus-Register Area (page 5-7), new modules added		X
	Parameters of the Modules (page 5-18), new modules added		X
	Diagnostic Messages of the Modules (page 5-45), new modules added		X
9	BL20-Approvals for Zone 2/ Division 2 → separate manual D301255		X

Note

The publication of this manual renders all previous editions invalid.

2 BL20 Philosophy

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2.1 The Basic Concept

BL20 is a modular IP20 I/O-system for use in industrial automation. It connects the sensors and actuators in the field to the higher-level master.

BL20 offers modules for practically all applications:

- Digital input and output modules
- Analog input and output modules
- Technology modules (RS232 interface,...)

A complete BL20 station counts as **one** station on the bus and therefore occupies **one** fieldbus address in any given fieldbus structure. A BL20 station consists of a gateway, power distribution modules and I/O-modules.

The connection to the relevant fieldbus is made via the bus-specific gateway, which is responsible for the communication between the BL20 station and the other fieldbus stations.

The communication within the BL20 station between the gateway and the individual BL20 modules is realized via an internal module bus.

Note

The gateway is the only fieldbus-dependent module on a BL20 station. All other BL20 modules are not dependent on the fieldbus used.

2.1.1 Flexibility

A BL20 station can contain modules in any combination, which means it is possible to adapt the system to practically all applications in automated industries.

2.1.2 Convenient Handling

All BL20 modules, with the exception of the gateway, consist of a base module and an electronic module.

The gateway and the base modules are either snapped onto a mounting rail or are directly mounted onto the machine frame. The electronic modules are plugged onto the appropriate base modules.

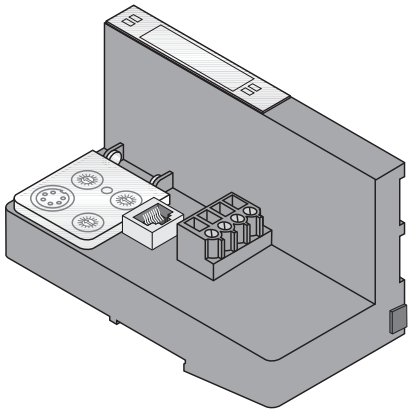
After disconnection of the load, the electronic modules can be plugged or pulled when the station is being commissioned or for maintenance purposes, without having to disconnect the field wiring from the base modules.

2.2 BL20 Components

2.2.1 Gateways

The gateway connects the fieldbus to the I/O-modules. It is responsible for handling the entire process data and generates diagnostic information for the higher-level master and the software tool I/O-ASSISTANT.

Figure 2-1: BL20 gateway



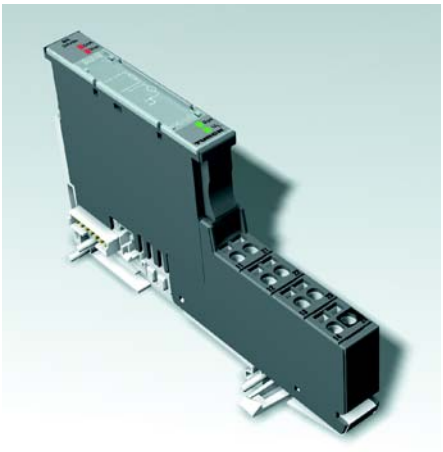
The BL20 gateways BL20-PG-EN offer an integrated power supply unit for feeding the gateway and the connected I/O modules.

It is not necessary to supply each individual module with a separate voltage.

2.2.2 Power Distribution Modules

The power supply for gateways and I/O modules is fed to the power distribution modules; therefore, it is not necessary to supply each individual module with a separate voltage.

Figure 2-2: Power distribution module



2.2.3 Electronics Modules

Electronics modules contain the functions of the BL20 modules (power distribution modules, digital and analog input/output modules, and technology modules).

Electronics modules are plugged onto the base modules and are not directly connected to the wiring. The assignment table in the Section “Ordering Information“ of the “Appendix“ shows the possible combinations of electronics and base modules. They can be plugged or pulled when the station is being commissioned or for maintenance purposes, without having to disconnect the field wiring from the base modules.

Figure 2-3: Electronics module in slice design

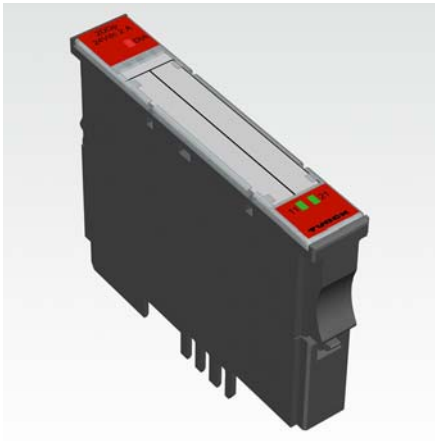
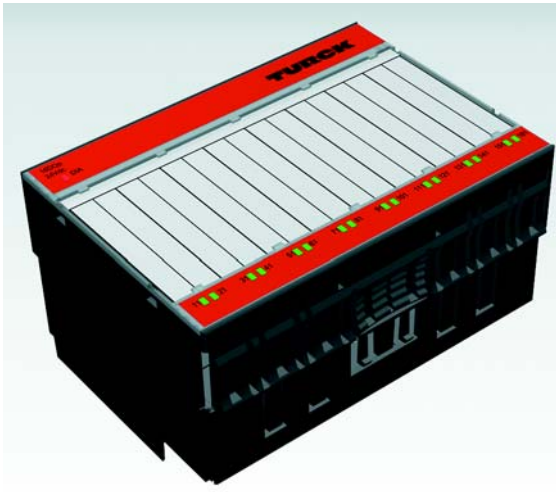


Figure 2-4: Electronics module in block design



2.2.4 Base Modules

The field wiring is connected to the base modules. These are constructed as terminals in block and slice designs and are available in the following variations with either tension clamp or screw connections: 2-/3-wire (2-channel), 4-wire (2-channel) and 4x 2-/3-wire (4-channel).

The assignment table in the Section “Ordering Information“ of the “Appendix“ shows the possible combinations of electronics and base modules.

Figure 2-5: Base module with tension clamp connection

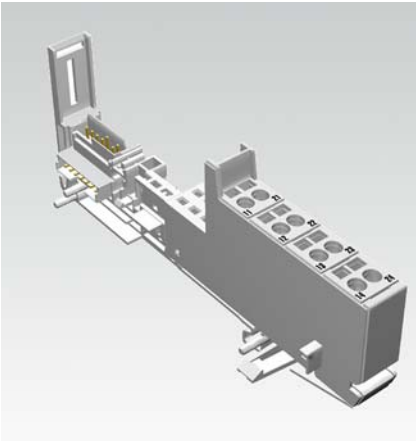


Figure 2-6: Base module with screw connection

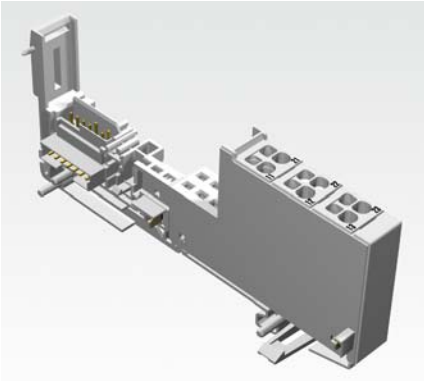
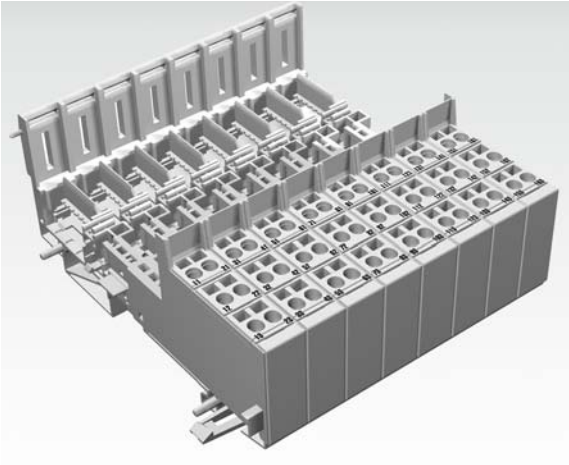


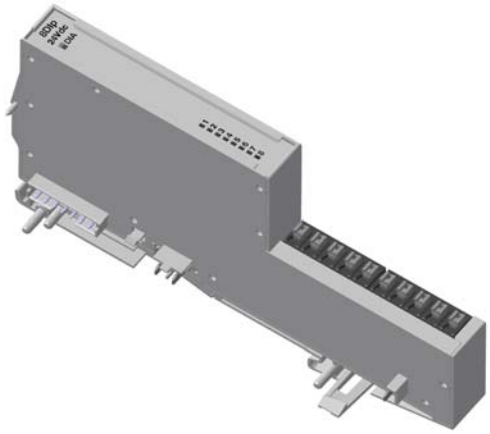
Figure 2-7: Base module in block design



2.2.5 BL20 Economy

With the BL20 Economy modules the electronics and connection technology is integrated into a single housing. Thus, the selection of a base module is unnecessary. Within a station the Economy modules can be combined with the modules with separate electronics/connection technology, provided that the base modules feature tension spring connections.

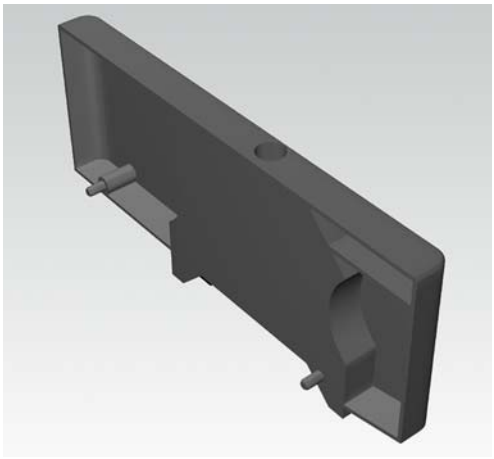
Figure 2-8: BL20 Economy



2.2.6 End Plate

An end plate on the right-hand side physically completes the BL20 station. An end bracket mounted into the end plate ensures that the BL20 station remains secure on the mounting rail even when subjected to vibration.

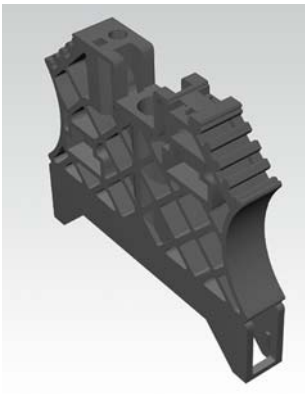
Figure 2-9: End plate



2.2.7 End Bracket

A second end bracket to the left of the gateway is necessary, as well as the one mounted into the end plate to secure the station.

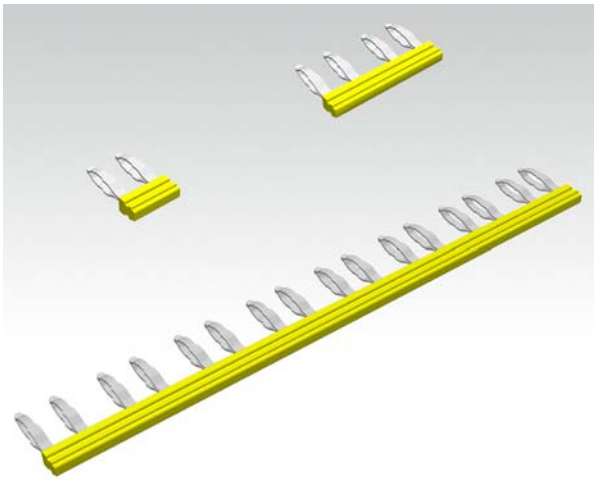
Figure 2-10: End bracket



2.2.8 Jumpers

Jumpers (QVRs) are used to bridge a connection level of a 4-wire base module. They can be used to connect potentials in relay modules (bridging the relay roots); thus considerably reducing the amount of wiring.

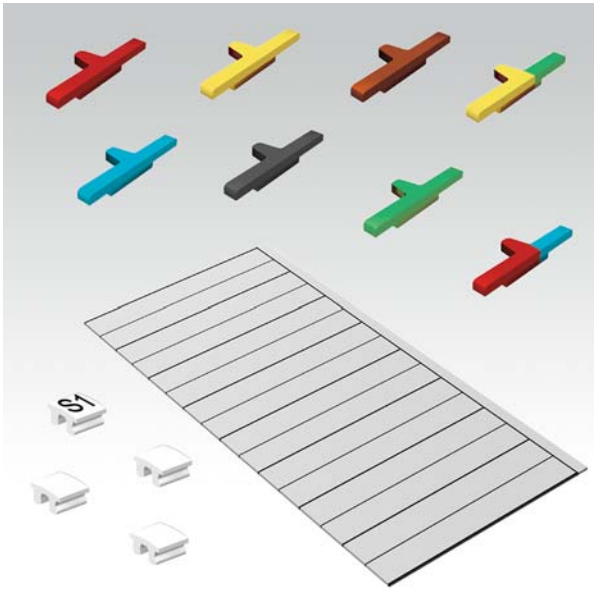
Figure 2-11: Jumpers



2.2.9 Marking Material

- Labels: for labeling BL20 electronics modules.
- Markers: for colored identification of connection levels of BL20 base modules.
- Dekafix connector markers: for numbering the mounting slots on BL20 base modules.

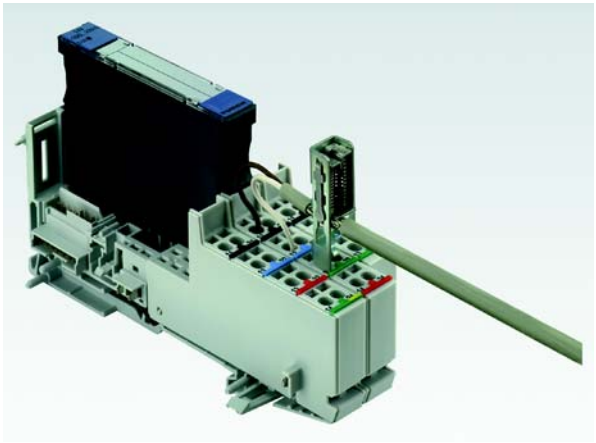
Figure 2-12: Marking material



2.2.10 Shield Connection, 2-Pole for Analog Modules

The 2-pole shield connection can be used to connect signal-cable shielding to the base modules of analog input and output modules. A special tension-clamp operating tool (BL20-ZBW5-2) is required to mount the shield connection onto the base module.

Figure 2-13: Shield connection



3 Ethernet

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– TCP (Transmission Control Protocol) 3
– Modbus TCP 4
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3.1.6 ARP (Address Resolution Protocol) 5
3.1.7 Transmission Media 5

3.1 System Description

Originally developed by DEC, Intel and Xerox (as DIX standard) for data transmission between office equipment, Ethernet stands for the IEEE 802.3 CSMA/CD specification published in 1985.

The rapid increase of application and the worldwide use of this technology enables problem-free and above all cost-effective connection to existing networks.

3.1.1 Ethernet MAC-ID

The Ethernet MAC-ID is a 6-byte-value which serves to definitely identify an Ethernet device. The MAC-ID is determined for each device by the IEEE (Institute of Electrical and Electronics Engineers, New York).

The first 3 bytes of the MAC-ID contain a manufacturer identifier (Turck: 00:07:46:××:××:××). The last 3 bytes can be chosen freely by the manufacturer for each device and contain a definite serial number.

A label on the TURCK modules shows the respective MAC-ID.

In addition to that, the MAC-ID can be read out using the software tool "I/O-ASSISTANT".

3.1.2 IP address

Each Ethernet-host receives its own IP address. In addition to that the node knows its netmask and the IP address of the default gateway.

The IP address is a 4-byte-value which contains the address of the network to which the node is connected as well as the host address in the network.

The IP address of the gateway BL20-PG-EN is predefined as follows:

IP address: 192.168.1.×××

netmask: 255.255.255.0

gateway: 192.168.1.1

The netmask shows which part of the IP address defines the network as well as the network class and which part of the IP address defines the single node in the network.

In the example mentioned above, the first 3 bytes of the IP address define the network. They contain the subnet-ID 192.168.1.
The last byte of the IP address defines the node's address within the network.

Note

In order to build up the communication between a PC and an Ethernet-module, both have to be nodes of the same network.

If necessary, the nodes' network addresses have to be adapted one to another. Please read chapter 10, Changing the IP address of a PC/ network interface card, page 10-2.

3.1.3 Network Classes

The available networks are divided into the different network classes A, B, and C.

Table 3-2: Network classes

Class	Network addresses	Bytes for net address	Bytes for host address	No. of the possible networks/ hosts
A	1.xxx.xxx.xxx -126.xxx.xxx.xxx	1	3	126/ 2^{24}
B	128.0.xxx.xxx -191.255.xxx.xxx	2	2	2^{14}/ 2^{16}
C	192.0.0.xxx - 223.255.255.xxx	3	1	2^{21}/ 256

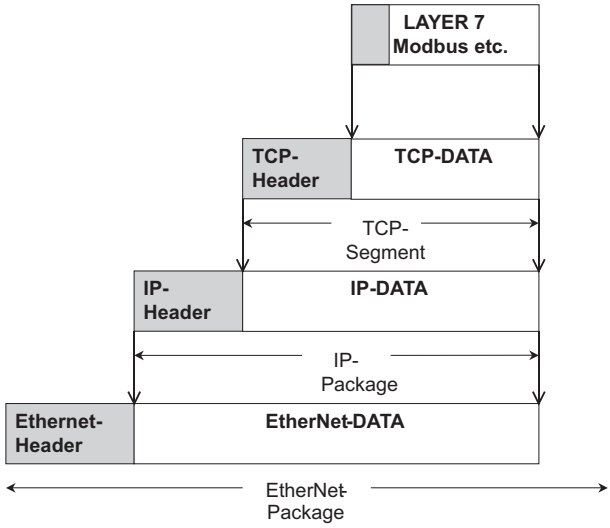
According to their predefined address 192.168.1.xxx the BL20 gateways are thus nodes of a Class C network.

3.1.4 Data transfer

The data are transferred from a transmitter to a receiver via the Ethernet. This data transfer uses no acknowledgement of reception, which means data telegrams can get lost. Data transfer via Ethernet without any protocol implementation can thus not be absolutely safe.

In order to assure a safe transmission of data, frame-protocols like TCP/IP are used.

Figure 3-14: Telegram structure



IP (Internet Protocol)

The Internet Protocol is a connection-free transport protocol. The protocol does not use acknowledgement messages, telegrams can get lost. It is thus not suitable for safe data transfer. The main functions of the internet protocol are the addressing of hosts and the fragmentation of data packages.

TCP (Transmission Control Protocol)

The Transmission Control Protocol (TCP) is a connection-oriented transport protocol and is based on the Internet Protocol. A safe and error-free data transport can be guaranteed by means of certain error diagnostic mechanisms as for example acknowledgement and time monitoring of telegrams.

Modbus TCP

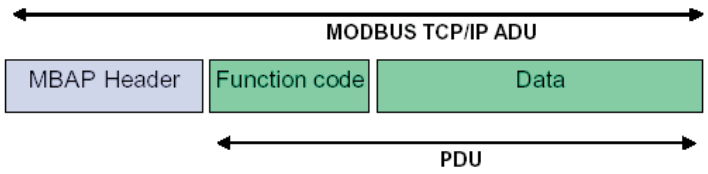
In Ethernet TCP/IP networks, Modbus TCP uses the Transport Control Protocol (TCP) for the transmission of the Modbus application protocol.

All parameters and data are embedded in the user data of the TCP-telegram using the encapsulation protocol: the client generates a special header (MBAP = Modbus Application Header), which enables the server to clearly interpret the received Modbus-parameters and -commands.

The Modbus protocol is thus part of the TCP/IP-protocol.

The communication via Modbus is realized by means of function codes embedded in the data telegram.

Figure 3-15: telegram structure Modbus TCP



The function codes contain, amongst others, commands for reading input data or writing output data. Please read chapter 5, section Implemented Modbus Functions, page 5-17 for further information about the function codes implemented in the BL20 gateway.

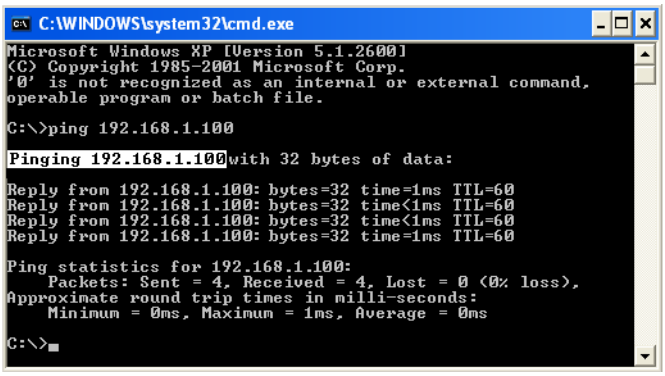
3.1.5 Checking the communication via "ping-signals"

You can check the communication between nodes in a network using ping-signals in the DOS-prompt of your PC.

For that purpose, please enter the command "ping" and the IP address of the network node to be checked.

If the node answers the ping-signal, it is ready for communication and takes part in the data transfer.

Figure 3-16: ping-signal


C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.
'0' is not recognized as an internal or external command,
operable program or batch file.
C:\>ping 192.168.1.100
Pinging 192.168.1.100with 32 bytes of data:
Reply from 192.168.1.100: bytes=32 time=1ms TTL=60
Reply from 192.168.1.100: bytes=32 time<1ms TTL=60
Reply from 192.168.1.100: bytes=32 time<1ms TTL=60
Reply from 192.168.1.100: bytes=32 time=1ms TTL=60
Ping statistics for 192.168.1.100:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>

3.1.6 ARP (Address Resolution Protocol)

In each TCP/IP-capable computer, ARP serves to clearly assign the worldwide unique hardware addresses (MAC-IDs) to the single IP addresses of the network nodes via internal tables.

Using ARP in the DOS-prompt, every node in a network can be clearly identified via its MAC-ID.

- Write a ping command for the respective station/ IP address: (example: "x:\\ping 192.168.1.100").
- Via the command "x:\\arp -a" the MAC-ID (00-07-46-ff-60-13) for this IP address is determined. This MAC-ID clearly identifies the network node.

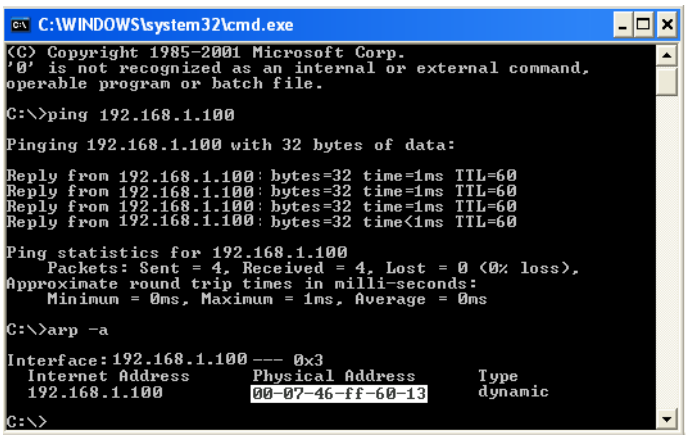


Figure 3-17: Determination of the MAC-ID of a BL20 module via ARP

3.1.7 Transmission Media

For a communication via Ethernet, different transmission media can be used (see chapter 8, page 3-5).

4 Technical Features

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4.1 General

This chapter contains the general technical description of the BL20 gateway for Ethernet. The following technical features are independent of the implemented protocol.
The chapter describes: the technical data, the connection possibilities, the addressing of the gateway etc.

4.2 Function

This chapter contains the general technical description of the programmable BL20 gateway for Modbus TCP.

4.3 Function

The programmable BL20 gateways can be used as an autonomous PLC or as a de-central PLC in a network interconnection for fast signal processing

Hinweis

The programmable BL20 gateway BL20-PG-EN is designed as a Single Task System.

The gateway handles the entire process data traffic between the I/O-level and the PLC runtime system.

4.3.1 Programming

The gateways BL20-PG-×××× are programmable according to IEC61131-3 using the software tool CoDeSys V2.3 from 3S - Smart Software Solutions GmbH.

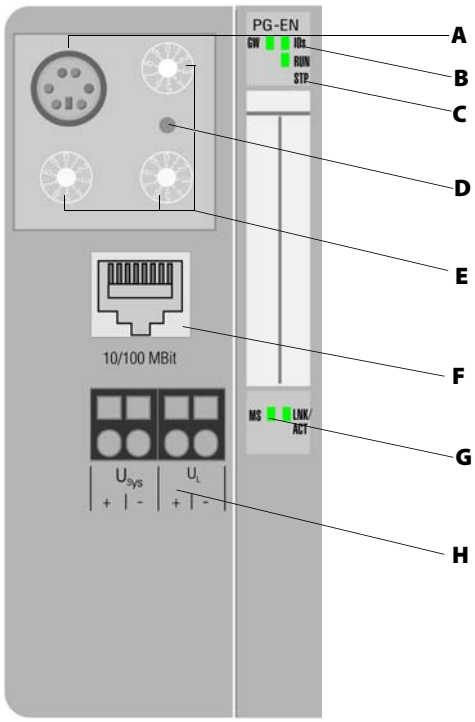
For programming the gateway, the following programming languages according the standards can be used:

LD	= Ladder
FDB	= Function Block Diagram
IL	= Instruction List
ST	= Structured Text
SFC	= Sequential Function Chart

4.4 Technical Data

Figure 4-18: BL20-PG-EN

A *service-interface*
B *module bus LEDs*
C *RUN/STOP-LEDs*
D *SET-button*
E *rotary coding switches*
F *Ethernet*
G *Ethernet LEDs*
H *power supply*



4.4.1 Gateway structure

The BL20 gateway has the following structure:

Figure 4-19: Gateway structure

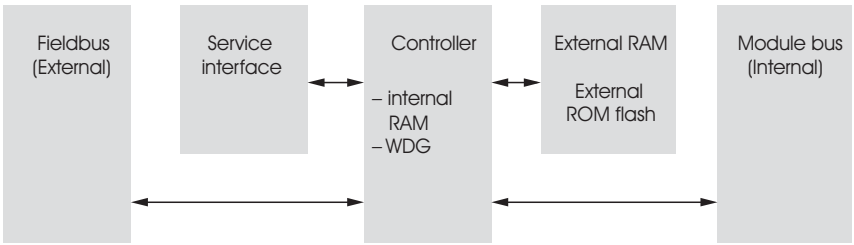


Table 4-3: Technical data Ethernet gateway

Supply voltage	
field supply	
U_L nominal value (permissible range)	24 VDC (18 to 30 VDC)
I_L max. field current	10 A
System	24 VDC
U_{sys} nominal value (permissible range)	24 VDC (18 to 30 VDC)
I_{sys}	max. 500 mA
I_{MB} (Supply of the module bus nodes)	max. 1,3 A
Physical interfaces	
field bus	
transmission rate	10/100 MBit
passive LWL can be connected	current consumption max. 100 mA
field bus connection technology	RJ45 female connector
field bus shielding connection	via Ethernet cable
Isolation voltages	
U_{RS} (Ethernet/ service interface)	500 V AC
U_{EN} (Ethernet/ module bus)	500 V DC
U_{sys} (U_L to U_{sys})	1000 V DC
PLC-data	
Programming	
– Software – Released for	CoDeSys V 2.3 V 2.3.5.8
– Programming languages	IEC 61131-3 (IL, LD, FDB, SFC, ST)
– Application tasks	1
– No. of POUs (Program Organization Unit)	1024
– Programming interfaces	RS232-interface, Ethernet

Processor	RISC, 32 bit
– Cycle time	< 1 ms for 1000 IL-commands (without I/O-cycle)
Memory	
– Program memory	512 KByte
– Data memory	512 KByte
– Input data	4 KByte (physical input data and network variables)
– Output data	4 KByte (physical output data and network variables)
– Non-volatile memory	16 KByte

Danger

This device can cause radio disturbances in residential areas and in small industrial areas (residential, business and trading). In this case, the operator can be required to take appropriate measures to suppress the disturbance at his own cost.

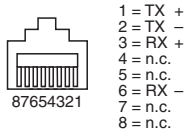
4.5 Connection possibilities

4.5.1 Field bus connection

Ethernet-connection

The connection to Ethernet is realized via female RJ45 connector:

Figure 4-20: female RJ45 connector



4.5.2 Power Supply via terminal block with screw connection

The power supply is realized via terminal block with screw connection technology.

Table 4-4: Pin assignment the terminal blocks

Signal	Description
U_{SYS} +	System supply (Gateway, module bus)
U_{SYS} -	
U_L+	Field supply (max. 10 A)
U_L-	

4.5.3 Service Interface Connection (female PS/2 connector)

The service interface is used to connect the gateway to the project planning and diagnostic software I/O-ASSISTANT.

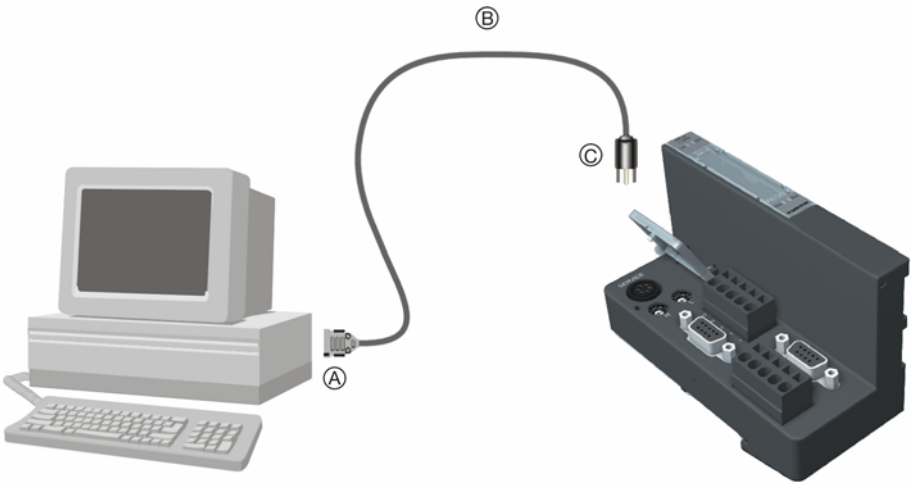
The service interface is designed as a 6 pole Mini-DIN-connection.

Two types of cables can be used to connect the service interface () to a PC.

- special I/O-ASSISTANT-connection cable from TURCK (IOASSISTANT-ADAPTERKABEL-BL20/BL67; Ident-no.: 6827133)
- Commercially available PS/2 cable with adapter cable SUB-D/ PS/2

Connection with I/O-ASSISTANT-Connection Cable

*Figure 4-21: BL20-gateway connected to PC via special cable^*



The I/O-ASSISTANT-cables have a PS/2 male connector (connection for female connector on gateway) and a SUB-D female connector (connection for male connector on PC).

Figure 4-22: PS/2 male connector on the connection cable to the gateway (top view)

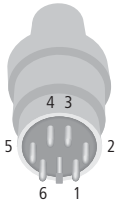
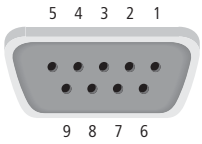


Figure 4-23: 9-pole SUB-D female connector on the cable for connecting to PC (top view)



4.6 Address Setting

The addressing of the BL20 Modbus TCP gateway can be realized via different modes:

- rotary mode (manual addressing via rotary coding-switches)
- PGM mode (manual addressing via software)
- BootP mode, DHCP mode (automatic addressing via BootP/DHCP-server at the boot-up of the gateway).

The setting of the address modes is done via the 3 rotary coding-switches at the gateway.

Note

It is not necessary to address the station's internal module bus.

Attention

The cover of the decimal rotary coding-switches must be closed by tightening the screw after use.

The seal in the cover must not be damaged or slipped.

The protection class IP67 can only be guaranteed when the cover is closed correctly.

4.6.1 LED-behavior

During it's start-up, the module waits for the address setting via the BootP-server. This is indicated by the red flashing "MS" LED. The LED begins to flash green, as soon as the address setting via the server is completed. The station is ready for communication.

4.6.2 Default setting of the gateway

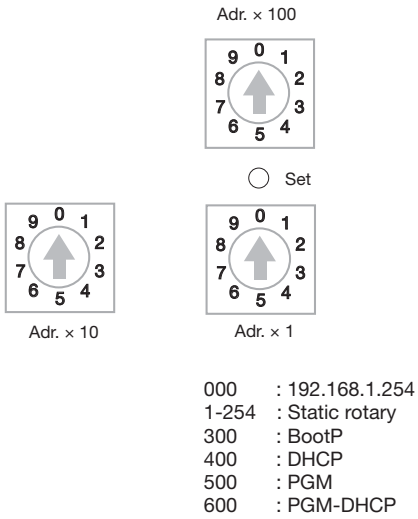
The gateway's default-settings are the following:

IP address	192.168.1.254
subnet mask	255.255.255.000
default gateway	192.168.1.001

Note

The gateway can be reset to these default settings by the user at any time.
To reset the gateway, please set the three coding-switches at the gateway to "000" followed by a power-on reset.

Figure 4-24: Decimal rotary coding-switches for the address setting



Attention

After every change of the address-mode, a voltage reset must be carried out.

4.6.3 Address setting via the rotary-mode

When using the rotary-mode, the last byte of the gateway's IP address can be set via the rotary coding-switches at the gateway.

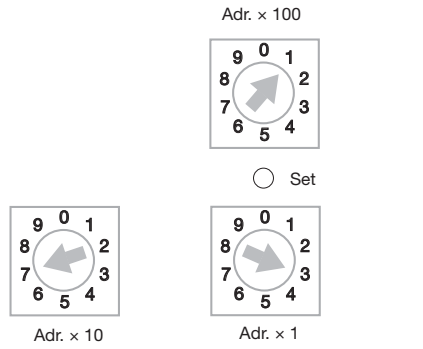
Note

All other network settings are stored in the module's non-volatile EEPROM and can not be changed in the rotary-mode.

Addresses in the range from 0 to 254 can be allocated. The addresses 0 and 255 are reserved for broadcast messages in the subnet.

The following example shows the setting of the address **173**.

Figure 4-25: Address setting



000 : 192.168.1.254
1-254 : Static rotary
300 : BootP
400 : DHCP
500 : PGM
600 : PGM-DHCP

Attention

The settings carried out in the rotary-mode are not stored in the module's EEPROM. Thus, they will get lost in case of a subsequent address-assignment via a BootP/ DHCP or PGM.

Attention

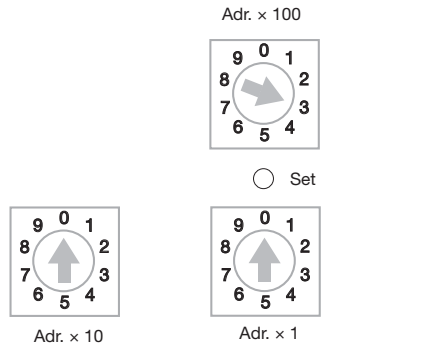
After changing the position of the rotary coding-switches, a voltage reset must be carried out to store the new address.

4.6.4 Address setting via BootP-mode

The address setting is carried out by a BootP-server in the network after the start-up of the gateway.

In order to activate the BootP-mode, the rotary coding-switches have to be set to "300".

Figure 4-26: BootP-mode



000 : 192.168.1.254
1-254 : Static rotary
300 : BootP
400 : DHCP
500 : PGM
600 : PGM-DHCP

Note

The IP address as well as the default subnet mask assigned to the gateway by the BootP-server are stored in the gateway's non-volatile memory.

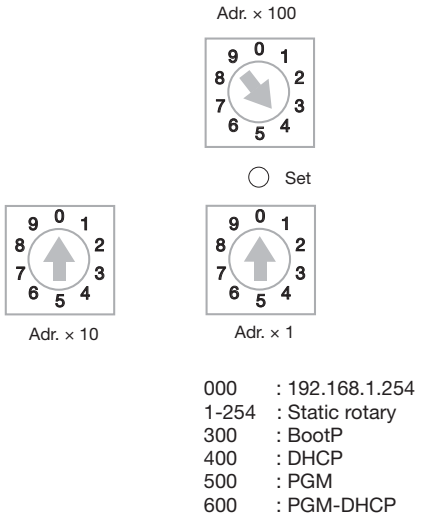
If the gateway is subsequently switched to rotary- or PGM-mode, the settings carried out via BootP (IP address, subnet mask, etc.) will be taken from the module's EEPROM.

4.6.5 Address setting via DHCP-mode

The address setting is carried out by a DHCP-server in the network after the start-up of the gateway.

In order to activate the DHCP-mode, the rotary coding-switches have to be set to "400".

Figure 4-27: DHCP-Modus



Note

The IP address as well as the default subnet mask assigned to the gateway by the DHCP-server are stored in the gateway's non-volatile memory.

If the gateway is subsequently switched to rotary- or PGM-mode, the settings carried out via DHCP (IP address, subnet mask, etc) will be taken from the module's EEPROM.

DHCP supports three mechanisms for IP address allocation:

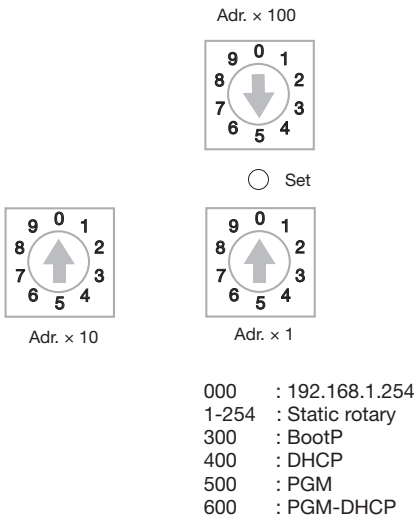
- In "automatic allocation", the DHCP-server assigns a permanent IP address to a client.
- In "dynamic allocation", DHCP assigns an IP address to a client for a limited period of time. After this time or until the client explicitly relinquishes the address, the address can be re-assigned.
- In "manual allocation", a client's IP address is assigned by the network administrator, and DHCP is used simply to convey the assigned address to the client.

4.6.6 Address setting via PGM-mode

The PGM-mode enables the access of I/O-ASSISTANTs to the module's network settings.

In order to activate the PGM-mode, the rotary coding-switches have to be set to "500".

Figure 4-28: PGM-mode



Note

In the PGM-mode, all network settings (IP address, subnet mask, etc.) are read from the module's internal EEPROM.

The settings carried out in the rotary-mode are stored in the module's non-volatile EEPROM.

4.6.7 Addressing via PGM-DHCP

The addressing of the BL20 Modbus TCP gateway via PGM-DHCP is at the moment comparable to the addressing via DHCP (see page 4-13).

4.6.8 Address-setting via I/O-ASSISTANT 3 (FDT/DTM)

The software I/O-ASSISTANT enables direct access to the Ethernet-network via the Ethernet-cable.

Naturally, the access to the single station via the service interface at the gateway is possible as well.

The IP address, as well as the subnet mask of the TURCK Ethernet modules, can be changed according to the application by using the Busaddress Management function of the BL Service Ethernet interface in the I/O-ASSISTANT.

Note

Please observe, the changing the IP-Address is only possible if the gateway is in **PGM**-mode (see also page 4-17) and when using the gateway's Ethernet interface. Select the interface "BL Service Ethernet" in the DTM and connect the gateway to the PC using the Ethernet port (page 4-8).

Changing the address using the RS232-interface is not possible.

Figure 4-29: BL Service Ethernet

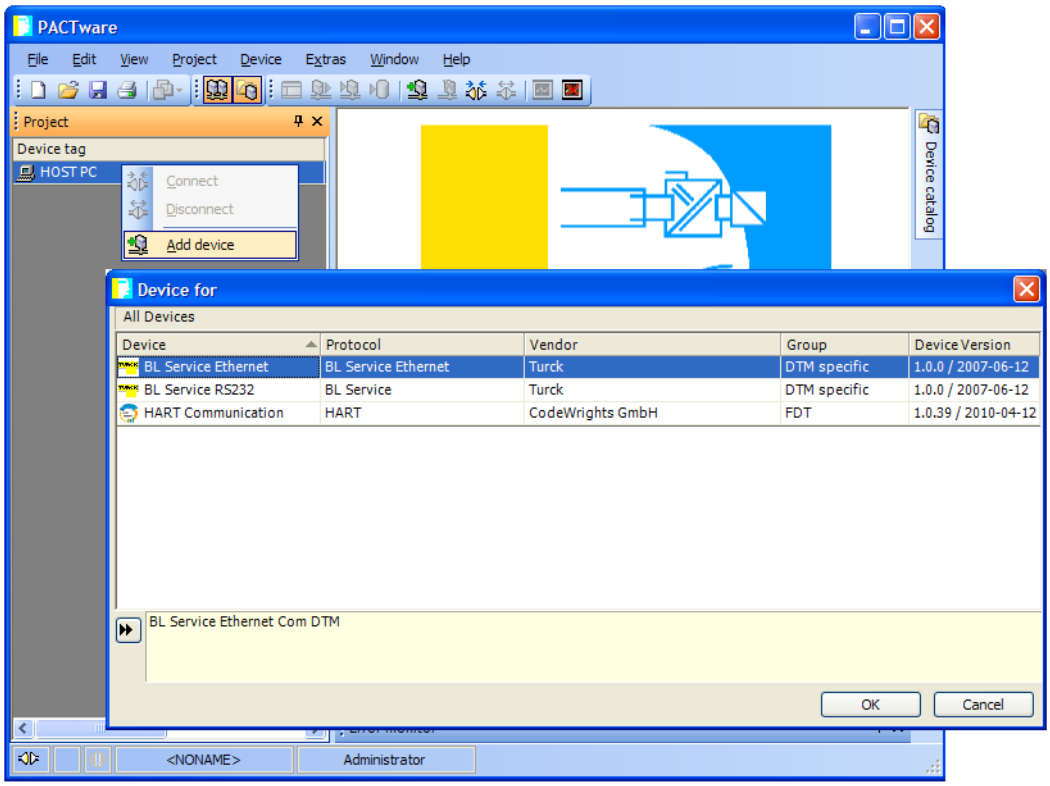


Figure 4-30: Busaddress management

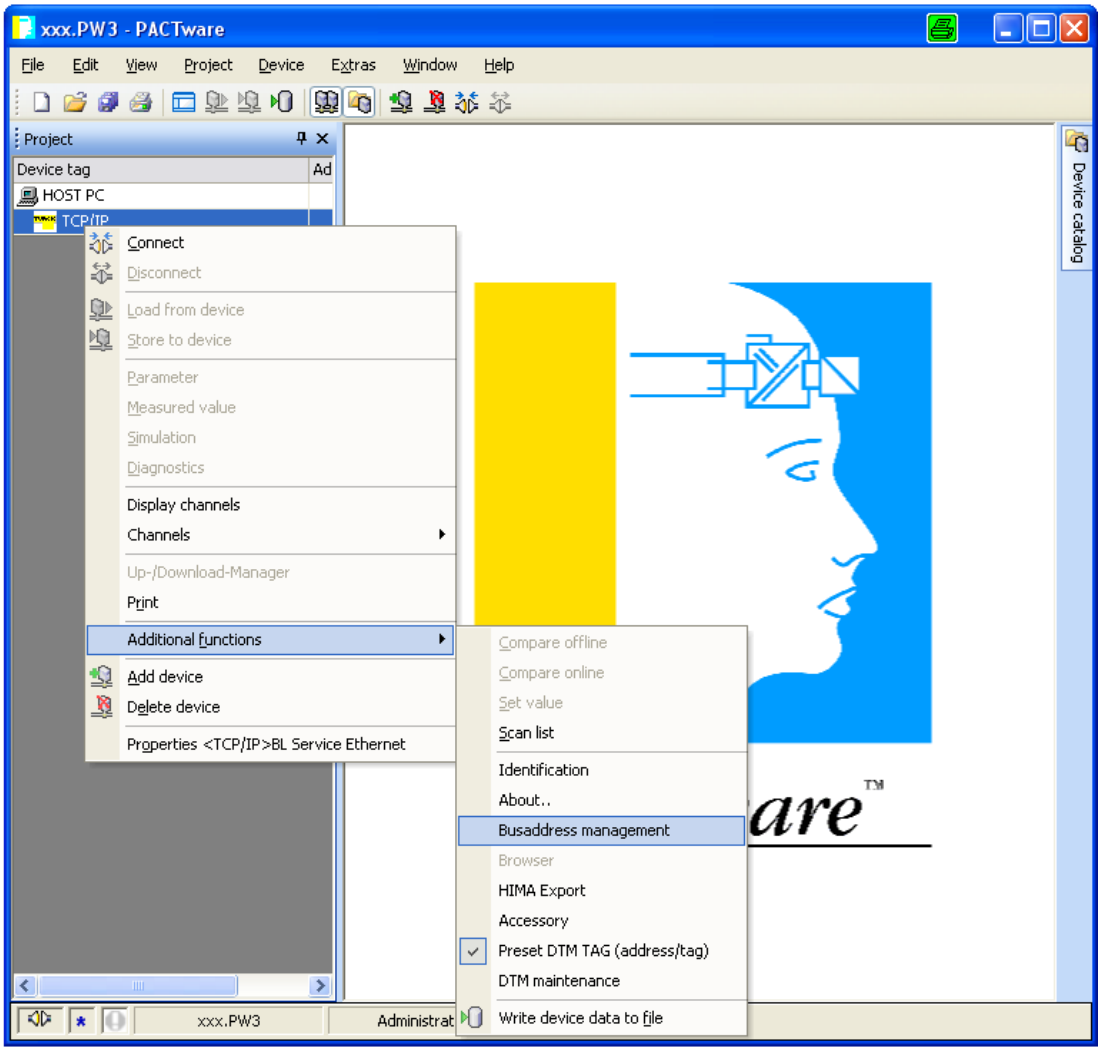
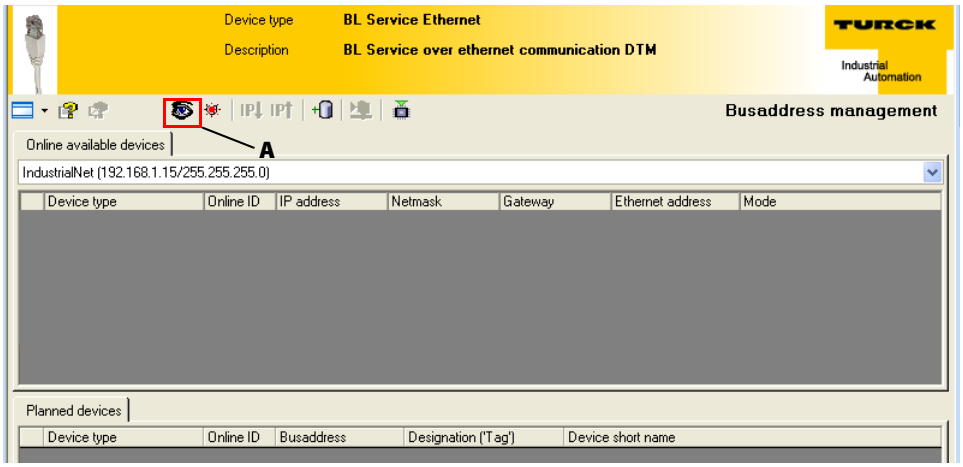


Figure 4-31: Search for Network- nodes

A *Search function in the busaddress management*



The IP address as well as the subnet mask of the TURCK Ethernet gateways can be changed according to the application by using the integrated Busaddress Management function in the IO-ASSISTANT 3 (FDT/DTM).

Note

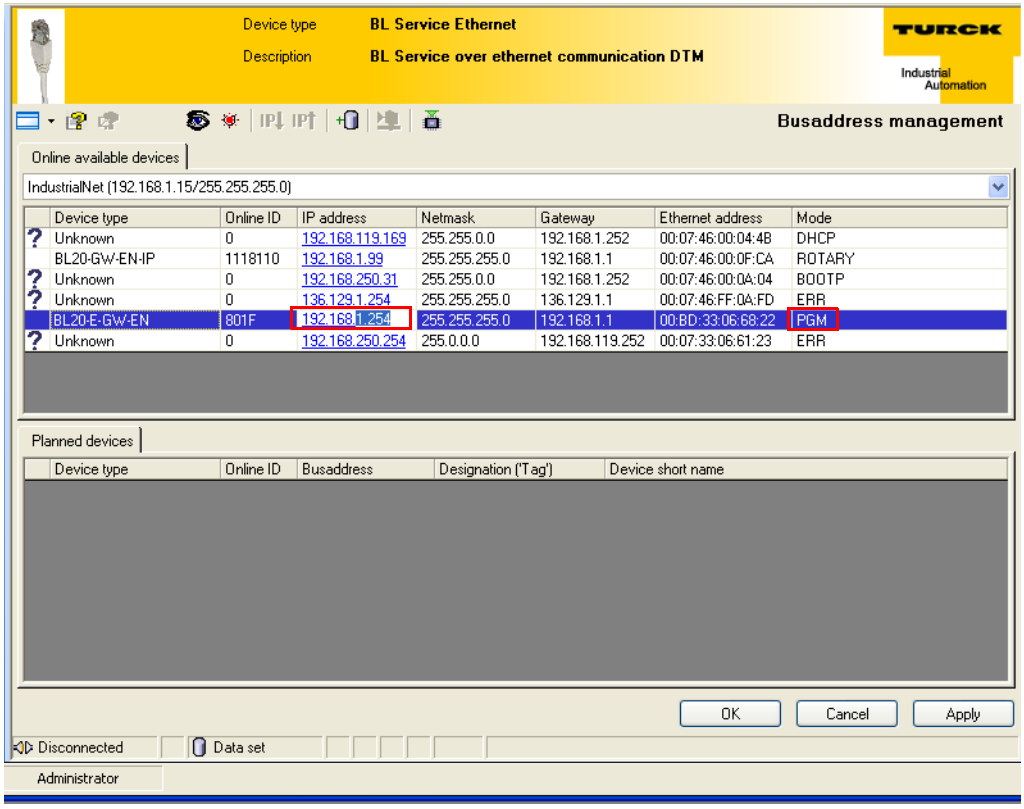
The access of the IO-ASSISTANT to the gateway is only possible if the gateway is operated in PGM-mode (see also Address setting via PGM-mode (page 4-14)).

Attention

When using Windows XP as operating system, difficulties may occur with system-integrated firewall.

It may inhibit the access of PACT*ware*™ (I/O-ASSISTANT V3) to the Ethernet-network. In this case, please adapt your firewall respectively or deactivate it (see also Deactivating/ adapting the firewall in Windows XP (page 10-5)).

Figure 4-32: Changing the IP-address


Device type
BL Service Ethernet
Description
BL Service over ethernet communication DTM
TURCK
Industrial Automation
Busaddress management
Online available devices
IndustrialNet (192.168.1.15/255.255.255.0)
Device type | Online ID | IP address | Netmask | Gateway | Ethernet address | Mode
Unknown | 0 | 192.168.119.169 | 255.255.0.0 | 192.168.1.252 | 00:07:46:00:04:4B | DHCP
BL20-GW-EN-IP | 1118110 | 192.168.1.99 | 255.255.255.0 | 192.168.1.1 | 00:07:46:00:0F:CA | ROTARY
Unknown | 0 | 192.168.250.31 | 255.255.0.0 | 192.168.1.252 | 00:07:46:00:0A:04 | BOOTP
Unknown | 0 | 136.129.1.254 | 255.255.255.0 | 136.129.1.1 | 00:07:46:FF:0A:FD | ERR
BL20-E-GW-EN | 801F | 192.168.1.254 | 255.255.255.0 | 192.168.1.1 | 00:BD:33:06:68:22 | PGM
Unknown | 0 | 192.168.250.254 | 255.0.0.0 | 192.168.119.252 | 00:07:33:06:61:23 | ERR
Planned devices
Device type | Online ID | Busaddress | Designation ('Tag') | Device short name
OK
Cancel
Apply
Disconnected
Data set
Administrator

Note

Please observe that chaning the IP-address is only possible via the Ethernet interface at the gateway, not via the RS232 interface.

4.7 SET Button

The Current Configuration of the station is saved as the Actual Configuration when the SET button on the gateway is pressed for approximately 10 seconds; it is also saved to the both the Temp-Required Configuration Memory and the Required Configuration Memory. The LED "GW" flashes.

4.8 Status Indicators/Diagnostic Messages Gateway

The gateway sends the following diagnostic messages:

- undervoltage monitoring for system- and field supply,
- monitoring of the station status,
- monitoring of the communication via the internal module bus,
- monitoring of the communication to Ethernet
- monitoring of the gateway status

Diagnostic messages are displayed in two different ways:

- via the LEDs
- via the respective configuration software

4.8.1 Diagnostic Messages via LEDs

Every BL20 gateway displays the following statuses via LEDs:

- 2 LEDs for module bus communication (module bus LEDs): **GW** and **IOs**
- 1 LED for displaying if the gateway/ the program in the gateway has started: **RUN/STP**
- 2 LEDs for the Ethernet communication (fieldbus-LEDs): **LINK/ACT** and **MS**.

Table 4-5: LED-displays

LED	Status	Meaning	Remedy
GW	Off	CPU not supplied.	
	Green	Firmware active, gateway ready to operate and transmit	-
	Green, flashing, 1 Hz	Firmware not active.	If LED "**IOs**" red → Firmware download necessary
	Green, flashing, 4 Hz	Firmware active, gateway hardware defect.	Replace the gateway.
	Red	Controller is not ready, VCC level is not within the required range → possible reasons: – too many modules connected to the gateway – short circuit in connected module – hardware error in gateway	– Check wiring at the gateway and the voltage supply. – Dismount modules – Replace the gateway.
IOs	Off	CPU not supplied.	– Check the voltage supply at the gateway.
	Green	Module bus is running, the configured module bus station corresponds to the physically connected station, communication is active.	-
	Green, flashing 1 Hz	Station is in the I/O-ASSISTANT Force Mode.	– Deactivate the I/O-ASSISTANT Force Mode.
	Green, flashing 4Hz	Maximum number of modules at the gateway is exceeded.	– Check the number of modules connected to the gateway, dismount modules
	Red	Controller is not ready, V_{CC} level is not within the required range → possible reasons: – too many modules connected to the gateway – short circuit in connected module – hardware error in – gateway	– Check wiring at the gateway and the voltage supply. – Dismount modules – Replace the gateway.
	Red flashing, 1 Hz	Non-adaptable modification of the physically connected station.	– Compare the planned BL20 station with the physical station. – Check the physical station for defective or incorrectly fitted electronics modules.
	Red flashing, 4 Hz	no module bus communication	– At least one module has to be plugged and has to be able to communicate with the gateway.

Table 4-5: LED-displays

LED	Status	Meaning	Remedy
	Red/green flashing, 1 Hz	Adaptable modification of the physically connected station; data transfer possible	– Check the physical station for pulled or new but not planned modules.
RUN/STP	Off	No program loaded into the gateway.	–
	Green	Application loaded to gateway, program running.	–
	Green flashing	Application loaded to gateway, PLC not yet started or stopped.	– Start the gateway/ the PLC program.
	Red	PLC test during gateway start.	–
LINK/ACT	Off	No Ethernet link	– Check the Ethernet-connection
	Green	Link, 100 Mbit	
	Green flashing	Ethernet Traffic 100 Mbit	
	Yellow	Link, 10 Mbit	
	Yellow, flashing	Ethernet Traffic 10 Mbit	
MS	Green	Displays the logical connection to a Master (1. Modbus TCP-connection)	
	Green, flashing	Gateway is ready for operation	
	Red	Gateway indicates error	
	Red, flashing	DHCP/BootP search of settings	

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5.1 Modbus Registers

As soon as an application is downloaded to the BL20-PG-EN, the programmable gateway simply allows read-only-access to the standard Modbus registers (0×0000h to 0×01FFh, 0×0800h to 0×09FFh).

A write-access is only possible using the Modbus output registers (register 0×4400 to 0×47FF, see following table).

Note

If no application is loaded to the BL20-PG-EN, the programmable gateway works as a standard-gateway for Modbus TCP.

Note

Some Modbus PLCs and/ or configuration tools do not define register-number 0×0000h as the starting address according to the Modbus specification. In this case, the address area may begin with decimal "1".

Table 5-6: Modbus registers of the gateway

ro = read only
rw = read write

Address (hex.)	Access	Description
0×0000 to 0×01FF	ro	packed process data of inputs (process data length of modules, see Table 5-7: Data Width of the I/O-Modules in the Modbus-Register Area (page 5-7))
0×0800 to 0×09FF	ro	packed process data of outputs (process data length of modules, see Table 5-7: Data Width of the I/O-Modules in the Modbus-Register Area (page 5-7))
0×1000 to 0×1006	ro	gateway identifier
0×100C	ro	gateway status (see Table 5-8: Register 100Ch: gateway-status)
0×1010	ro	process image length in bit for the intelligent output modules
0×1011	ro	process image length in bit for the intelligent input modules
0×1012	ro	process image length in bit for the digital output modules
0×1013	ro	process image length in bit for the digital input modules
0×1017	ro	register-mapping revision (always 1, if not, mapping is incompatible with this description)
0×1018 to 0×101A	ro	group diagnostics of I/O-modules 0 to 74 (1 bit per I/O-module)
0×1020	ro	watchdog, actual time [ms]

Table 5-6: Modbus registers of the gateway

ro = read only
rw = read write

Address (hex.)	Access	Description
0×1120	rw	watchdog predefined time [ms] (default: 0)
0×1121	rw	watchdog reset register
0×1130	rw	modbus connection mode register, page 5-10
0×1131	rw	modbus connection time-out in seconds (default: 0 = never)
0×113C to 0×113D	rw	modbus parameter restore, page 5-10
0×113E to 0×113F	rw	modbus parameter save, page 5-11
0×2000 to 0×207F	rw	service-object, request-area, page 5-12
0×2080 to 0×20FF	ro	service-object, response-area, page 5-12
0×2400	ro	system voltage U_{SYS} [mV]
0×2401	ro	load voltage U_L [mV]
0×2405	ro	load current I_L [A]
0×27FE	ro	no. of entries in actual module list
0×27FF	ro	no. of entries in reference module list
0×2800 to 0×2840	ro	reference module list (74× 4 bytes per module-ID)
0×2900 to 0×29A0	ro	reserved
0×2A00 to 0×2A20	ro	actual module list (74× 4 bytes per module-ID)
0x4000 to 0x43FF	rw	Modbus input registers (SPS application-registers, see also Mapping the Modbus registers (page 5-16)).
0x4400 to 0x47FF		Modbus output registers Modbus-communication of the programmable gateway with a higher-level Modbus-client (i.e. PLC or OPC-server). See also Figure 5-33: Mapping the Modbus registers (page 5-16).
0×8000 to 0×893F	ro	process data inputs (max. 74 modules per station × 32 registers per module)
0×9000 to 0×993F	ro	process data outputs (max. 74 modules per station × 32 registers per module)

Table 5-6: Modbus registers of the gateway

ro = read only
rw = read write

Address (hex.)	Access	Description
0×A000 to 0×A93F	ro	diagnostics (max. 74 modules per station × 32 registers per module)
0×B000 to 0×B93F	ro	parameters (max. 74 modules per station × 32 registers per module)

5.2 Structure of the Packed In-/ Output Process Data

In order to assure a largely efficient access to the process data of a station, the module data are consistently packed and mapped to a coherent register area.

The I/O-modules are divided into digital and intelligent modules (analog modules, serial interfaces).

Both module types are mapped in separate register ranges.

The data mapping always starts with the mapping of the intelligent modules. Each module occupies as much Modbus registers as necessary, depending on it's data width. At least one register is occupied. A RS232-module, for example, occupies 4 consecutive registers (8 bytes) in the input and in the output area.
The data byte arrangement is done according to the physical order in the station, from the left to the right.

The data of the intelligent modules are followed by the data of the digital modules, also structured according to their physical appearance in the station. The Modbus registers for the digital data are filled-up up to 16 bit. This means on the one hand that one Modbus register can contain data of different digital modules and on the other hand that the data of one digital module can be distributed over multiple registers. Bit 0 of a digital module is thus not obligatory located on a word limit.

5.2.1 Packed input-process data

- input register area: **0000h** to **01FFh**

0000h			**01FFh**
intelligent modules, input data	digital input modules	status/ diagnosis	free

Note

Independent of the I/O-configuration, an access to all 512 registers is always possible. Registers that are not used send "0".

Status/ diagnostics

The area "status/diagnosis" comprises a maximum of 9 registers.

The first register contains a common gateway-/station-status.

The following registers (max. 8) contain a group diagnostic bit for each I/O-module which shows whether a diagnostic message is pending for the relevant module or not.

Status/ diagnostics **n + 0000h**		**n + 0008h**
gateway status (Reg. 100Ch)	group diagnosis I/O-modules 0...127 (registers 1018h to 101Fh)	

5.2.2 Packed output process data

- output register area: **0800h** to **09FFh**

0800h		**09FFh**
intelligent modules, output data	digital output data	free

Note

Independent of the I/O-configuration, an access to all 512 registers is always possible. Registers that are not used send a "0" answering read access, write accesses are ignored.

5.3 Data Width of the I/O-Modules in the Modbus-Register Area

The following table shows the data width of the BL20 I/O-modules within the modbus register area and the type of data alignment.

Table 5-7: Data width of the I/O-modules

Module	Process input	Process output	Alignment
– digital inputs			
BL20-2DI-x	2 bit	-	bit by bit
BL20-4DI-x	4 bit	-	bit by bit
BL20-E-8DI-x	8 bit	-	bit by bit
BL20-16DI-x	16 bit	-	bit by bit
BL20-32DI-x	32 bit	-	bit by bit
BL20-E-16DI-x	16 bit	-	bit by bit
BL20-8DI-x	8 bit	-	bit by bit
– digital outputs			
BL20-2DO-x	-	2 bit	bit by bit
BL20-4DO-x	-	4 bit	bit by bit
BL20-E-8DO-x	-	8 bit	bit by bit
BL20-16DO-x	-	16 bit	bit by bit
BL20-E-16DO-x	-	16 bit	bit by bit
BL20-32DO-x	-	32 bit	bit by bit
– analog inputs			
BL20-1AI-x	1 word		word by word
BL20-2AI-x	2 words		word by word
BL20-2AIH-I	12 words		word by word
BL20-4AI-x	4 words		word by word
BL20-E-8AI-U/I-4PT/NI	8 words		word by word
– analog outputs			
BL20-1AO-x		1 word	word by word
BL20-2AO-x		2 words	word by word
BL20-2AOH-I	8 words	2 words	word by word
BL20-E-4AO-U/I		4 words	word by word

Table 5-7: Data width of the I/O-modules

Module	Process input	Process output	Alignment
– technology modules			
BL20-1RS×××	4 words	4 words	word by word
BL20-1SSI	4 words	4 words	word by word
BL20-1CNT	4 words	4 words	word by word
BL20-E-2CNT-2PWM	12 words	12 words	word by word
BL20-E-SWIRE **A**	4 words	4 words	word by word
– power supply modules			
BL20-BR-×	-		
BL20-PF-×	-		

A *The process data of the SWIRE-modules are mapped into the data area for digital in-andoutput modules*

5.4 Register 100Ch: "Gateway-Status"

This register contains a general gateway-/ station-status.

Table 5-8: Register 100Ch: gateway-status

Bit	Name	Description
Gateway		
15	I/O Controller Error	The communication controller for the I/O-system is faulty.
14	Force Mode Active Error	The Force-Mode it activated. The state of the outputs may no longer accord to the settings made via the fieldbus.
13	reserved	-
12	Modbus Wdog Error	A time-out in the Modbus communication occurred.
Module bus		
11	I/O Cfg Modified Error	The I/O-configuration has been changed and is now incompatible.
10	I/O Communication Lost Error	No communication on the I/O-module bus.
Bit	**Name**	**Description**
Voltage errors		
9	V_I too low	System supply voltage too low (< 18 VDC).
8	V_I too high	System supply voltage too high (> 30 VDC).
7	V_O too low	Load voltage too low (< 18 VDC).
6	V_O too high	Load voltage too high (> 30 V).
5	I_{sys} too high	Overload of the system voltage supply.
4	reserved	-
Warnings		
3	I/O Cfg Modified Warning	
0	I/O Diags Active Warning	At least one I/O-module sends active diagnostics.

5.5 Register 1130h: "Modbus-connection-mode"

This register defines the behavior of the Modbus connections:

Table 5-9: register 1130h: Modbus-Connection-Mode

Bit	Name	Description
15 to 2	reserved	
1	**MB_ImmediateWritePermission**	
		– 0: With the first write access, a write authorization for the respective Modbus-connection is requested. If this request fails, an exception response with exception-code 01h is generated. If the request is accepted, the write access is executed and the write authorization remains active until the connection is closed. – 1:The write authorization for the respective Modbus-connection is already opened during the establishment of the connection. The first Modbus-connection thus receives the write authorization, all following connections don't (only if bit 0 = 1).
0	**MB_OnlyOneWritePermission**	
		– 0: all Modbus-connections receive the write authorization – 1: only one Modbus-connection can receive the write permission. A write permission is opened until a Disconnect. After the Disconnect the next connection which requests a write access receives the write authorization.

5.6 Register 1131h: "Modbus-connection time-out"

This register defines after which time of inactivity a Modbus-connection is closed through a Disconnect.

5.7 Register 0×113C and 0×113D: "Restore Modbus-connection parameter"

Registers 0×113C and 0×113D serve for resetting the parameter-register 0×1120 and 0×1130 to 0×113B to the default settings.

For this purpose, write "0×6C6F" in register 0×113C. To activate the reset of the registers, write "0×6164" ("load") within 30 seconds in register 0×113D.

Both registers can also be written with one single request using the function codes FC16 and FC23.

The service resets the parameters without saving them. This can be achieved by using a following "save" service.

5.8 Register 0×113E and 0×113F: "Save Modbus-connection parameters"

Registers 0×113E and 0×113F are used for the non-volatile saving of parameters in registers 0×1120 and 0×1130 to 0×113B.

For this purpose, write "0×7361" in register 0×113E. To activate the saving of the registers, write "0×7665" ("save") within 30 seconds in register 0×113F.

Both registers can also be written with one single request using the function codes FC16 and FC23.

5.9 The Service-Object

The service-object is used to execute one-time or acyclic services. It is an acknowledge service which may serve, for example, to parameterize an I/O-module.

2000h	2080h	20FFh
service request area	service response area	

The service request area allows write access, the service response area only read access.

- Service request area

2000h	2001h	2002h	2003h	2004h	2005h	20FFh
service no.	reserved	service code	index/ addr	data-reg-count	optional data (0 to122 registers)	

The register **service no.** in the request area can contain a user defined value which is deleted after the execution of the service.

The register **service code** specifies which service is requested.

The register **index/addr** is optional and the meaning depends on the particular service.

The register **data-reg-count** contains, depending on the service, the number (0 to 122) of the transferred or of the requested data registers.

Depending on the service, the **optional data** area can contain additional parameters and/or other data to be written.

- Service response area

2080h	2081h	2082h	2083h	2084h	2085h	20FFh
service no.	result	service code	index/ addr	data-reg-count	optional data (0 to 122 registers)	

After the execution of a request, the registers **service-no.**, **service code** and **index/addr** in the response area contain a copy of the values in the request area.

Note

The service no. is thus used for a simple handshake on the application level. The application increases the service no. with every request. The service is blocked, until the service number in the request area matches the service number in the response area.

The register **result** shows whether the execution was successful or not.

The register **data-reg-count** contains the number of data registers (0 to 122).

The **optional Data** area can contain, depending on the service, the requested data.

Supported service numbers::

Table 5-10: Supported service numbers:

Service code	Meaning
0×0000	no function
0×0003	indirect reading of registers
0×0010	indirect writing of registers

A service request may have the following results:

Table 5-11: results of the service request

Service code	Meaning
0×0000	error free execution of service
0×FFFE	service parameters incorrect/ inconsistent
0×FFFF	service code unknown

Note

The services "indirect reading of registers" and "indirect writing of registers " offer an additional possibility to access any Modbus register.

Current Modbus-masters support only a limited number of register- areas that can be read or written during the communication with a Modbus-server. These areas can not be changed during operation.

In this case, the services mentioned above enables non-cyclic access to registers.

5.9.1 "Indirect reading of registers"

1 to 122 (Count) Modbus-registers are read, starting with address x (Addr).

- service-request

2000h	2001h	2002h	2003h	2004h	2005h	207Fh
service no.	0x0000	0x0003	Addr	Count	reserved	

- service-response

2080h	2081h	2082h	2083h	2084h	2085h	20FFh
service no.	result	0x0003	Addr	Count	register contents	

5.9.2 "Indirect writing of registers"

1 to 122 (Count) Modbus-registers are written, starting with address x (Addr).

- service-request

2000h	2001h	2002h	2003h	2004h	2005h	207Fh
service no.	0x0000	0x0010	Addr	Count	register contents	

- service-response

2080h	2081h	2082h	2083h	2084h	2085h	20FFh
service no.	result	0x0010	Addr	Count	reserved	

5.10 Mapping: Input-Discrete- and Coil-Areas

Function codes FC1 ("Read Coils"), FC2 ("Read Discrete Inputs"), FC 5 ("Write Single Coil") and FC15 ("Write Multiple Coils") allow single-bit access to in- and output data.

The data mapping in these areas is the following:

- Mapping: input-discrete-area
  All digital inputs are stored in this area (offset "0").
- Mapping: Coil-area
  All digital outputs are stored in this area (offset "0").

Note

In addition to that, digital in- and outputs can also be accessed via the packed process data, page 5-5 within the Modbus registers of the gateway.
In the Modbus registers, the digital I/O data are stored with a variable offset, depending on the station's I/O-configuration.

5.11 Mapping the Modbus Registers

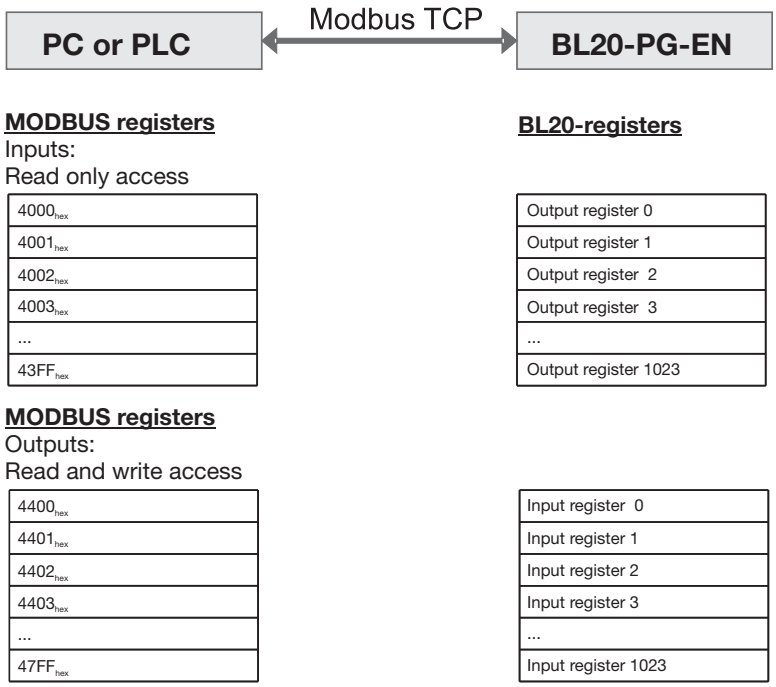

Figure 5-33: Mapping the Modbus registers

5.12 Implemented Modbus Functions

The BL20 gateway for Ethernet supports the following functions for accessing process data, parameters, diagnostics and other services.

Table 5-12: Implemented functions

Function Codes	
No.	**Function** Description
1	**Read Coils** Serves for reading multiple output bits.
2	**Read Discrete InputS** Serves for reading multiple input bits
3	**Read Holding Registers** Serves for reading multiple output registers
4	**Read Input Registers**
	Serves for reading multiple input registers
5	**Write Single Coil**
	Serves for writing single output bits
6	**Write Single Register**
	Serves for writing single output registers
15	**Write Multiple Coils**
	Serves for writing multiple output bits
16	**Write Multiple Registers**
	Serves for writing multiple output registers
23	**Read/Write Multiple Registers**
	Serves for reading and writing multiple registers

5.13 Parameters of the Modules

5.13.1 Digital input modules

- BL20-4DI-NAMUR

Table 5-13: Module parameters

A *Default settings*

Byte	Bit	Parameter name	Vale - Meaning
0 to 3	0	input filter×	0 = deactivate – (input filter 0,25 ms) **A** 1 = activate – (input filter 2,5 ms)
	1	digital input ×	0 = normal **A:** – input signal not inverted. 1 = inverted: – input signal inverted, conversion of the effective signal direction for sensors
	2	Short-circuit diagnostics x	0 = deactivate **A** 1 = activate
	3	Short-circuit monitoring x	0 = deactivate **A** 1 = activate
	4	Open circuit monitoring x	0 = deactivate **A** 1 = activate
	5	Open circuit diagnostics x	0 = deactivate **A** 1 = activate
	6	Input on diagnostic	0 = output substitute value **A** 1 = hold current value
	7	Substitute value on diagnostic	0 = on **A** 1 = off

5.13.2 Analog input modules

- BL20-1AI-I(0/4...20MA)

Table 5-14: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value – Meaning
0	0	current mode	0 = 0...20 mA **A**
			1 = 4...20 mA
	1	value representation	0 = Integer (15 bit + sign) **A**
			1 = 12 bit (left justified)
	2	diagnosis	0 = activate **A**
			1 = deactivate

- BL20-2AI-I(0/4...20MA) (1 byte parameter per channel)

Table 5-15: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value – Meaning
0/1	0	current mode	0 = 0...20 mA **A**
			1 = 4...20 mA
	1	value representation	0 = Integer (15 bit + sign) **A**
			1 = 12 bit (left justified)
	2	diagnosis	0 = activate **A**
			1 = deactivate
	3	channel	0 = activate **A**
			1 = deactivate

- BL20-1AI-U(-10/0...10V)

Table 5-16: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value – Meaning
0	0	voltage mode	0 = 0...10 V **A**
			1 = -10...+10 V
	1	value representation	0 = Integer (15 bit + sign) **A**
			1 = 12 bit (left justified)
	2	diagnosis	0 = activate **A**
			1 = deactivate

- BL20-2AI-U(-10/0...10V) (1 byte parameter per channel)

Table 5-17: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value – Meaning
0/1	0	voltage mode	0 = 0...10 V **A**
			1 = -10...+10 V
	1	value representation	0 = Integer (15 bit + sign) **A**
			1 = 12 bit (left justified)
	2	diagnosis	0 = activate **A**
			1 = deactivate
	3	channel	0 = activate **A**
			1 = deactivate

- BL20-2AI-PT/NI-2/3 (2 byte parameter per channel)

Table 5-18: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value – Meaning
0/2	0	mains suppression	0 = 50 Hz **A**
			0 = 60 Hz
	1	value representation	0 = Integer (15 bit + sign) **A**
			1 = 12 bit (left justified)
	2	diagnosis	0 = release **A**
			1 = block
	3	channel	0 = activate **A**
			1 = deactivate
	7 to 4	element	0000 = Pt100, -200...850 °C**A** 0001 = Pt100, -200...150 °C 0010 = Ni100, -60...250 °C 0011 = Ni100, -60...150 °C 0100 = Pt200, -200...850 °C 0101 = Pt200, -200...150 °C 0110 = Pt500, -200...850 °C 0111 = Pt500, -200...150 °C 1000 = Pt1000, -200...850 °C 1001 = Pt1000, -200...150 °C 1010 = Ni1000, -60...250 °C 1011 = Ni1000, -60...150 °C 1100 = resistance, 0...100 Ω 1101 = resistance, 0...200 Ω 1110 = resistance, 0...400 Ω 1111 = resistance, 0...1000 Ω
1/3	0	measurement mode	0 = 2-wire **A**
			1 = 3-wire

- BL20-2AI-THERMO-PI (2 byte parameter per channel)

Table 5-19: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value – Meaning
0/1	0	mains suppression	0 = 50 Hz **A**
			0 = 60 Hz
	1	value representation	0 = Integer (15 bit + sign) **A**
			1 = 12 bit (left justified)
	2	diagnosis	0 = release **A**
			1 = block
	3	channel	0 = activate **A**
			1 = deactivate
	7 to 4	element	0000 = type K, -270...1370 °C**A** 0001 = type B, +100...1820 °C 0010 = type E, -270...1000 °C 0011 = type J, -210...1200 °C 0100 = type N, -270...1300 °C 0101 = type R, -50...1760 °C 0110 = type S, -50...1540 °C 0111 = type T, -270...400 °C 1000 = ± 50 mV 1001 = ± 100 mV 1010 = ± 500 mV 1011 = ± 1000 mV ... reserved

- BL20-2AIH-I

Table 5-20: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value
0 (channel 1)	0	Channel	0 = activate **A**
			1 = deactivate
	1	Short-circuit diagnostics	0 = block
			1 = release **A**
	2	Wire Break diagnostics	0 = block
			1 = release **A**
	3 + 4	Operation mode	0 = 0… 20 mA (HART®-status polling not possible)
			1 = 4…20 mA (HART®-status polling not possible)
			2 = 4…20 mA HART® aktiv **A** Cyclic polling of the HART®-Status is activated.
	5 + 6	reserved	
	7	HART®-diagnostic	0 = release **A**
			1 = block
1 (channel 1)	0 + 1	Value representation	0 = Integer (15 bit + sign)**A**
			1 = NE 43
			2 = Extended Range
2 + 3 (channel 2)		analog to byte 0 + 1	
4	HART®-variable A		Defines the channel from which the HART®-variable is read.
	0	Mapped channel Vx	0 = channel 1
			1 = channel 2
	6 + 7	Mapped variable Vx	Defines which HART®-variable of the connected sensor is mapped into the module's process data.
			0 = PV (primary variable)
			1 = SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)

Table 5-20: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value
5	HART®-variable B		Defines the channel from which the HART®-variable is read.
	0	Mapped channel Vx	0 = channel 1
			1 = channel 2
	6 + 7	Mapped variable Vx	Defines which HART®-variable of the connected sensor is mapped into the module's process data.
			0 = PV (primary variable)
			1 = SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)
6	HART®-variable C		Defines the channel from which the HART®-variable is read.
	0	Mapped channel Vx	0 = channel 1
			1 = channel 2
	6 + 7	Mapped variable Vx	Defines which HART®-variable of the connected sensor is mapped into the module's process data.
			0 = PV (primary variable)
			1 = SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)
7	HART®-variable D		Defines the channel from which the HART®-variable is read.
	0	Mapped channel Vx	0 = channel 1
			1 = channel 2
	6 + 7	Mapped variable Vx	Defines which HART®-variable of the connected sensor is mapped into the module's process data.
			0 = PV (primary variable)
			1 = SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)

- BL20-4AI-U/I (1 byte parameter per channel)

Table 5-21: Module parameters

Byte	Bit	Parameter name	Value – Meaning
0 to 3	0	range	0 = 0...10 V/ 0...20 mA **A**
			1 = -10...+10 V/ 4...20 mA
	1	value representation	0 = Integer (15 bit + sign) **A**
			1 = 12 bit (left justified)
	2	diagnosis	0 = release **A**
			1 = block
	3	channel	0 = activate **A**
			1 = deactivate
	4	operation mode	0 = voltage **A**
			1 = current

A *Default-settings*

- BL20-E-8AI-U/I-4PT/NI (1 byte per channel)

Table 5-22: Module parameters

A *Default-settings*
B *3-wire-measurment: only the first of the used channels Kanäle has to be parameterized respectively. The parameterization of the second channel is ignored.*

Byte	Bit	Parameter name	Value	Meaning
0 to 7	0 to 5	Operation mode Kx	000000	voltage, -10...10 VDC, standard **A**
			000001	voltage, 0...10 VDC, standard
			000010	voltage, -10...10 VDC, NE 43
			000011	voltage, 0...10 VDC, NE 43
			000100	voltage, -10...10 VDC, extended range
			000101	voltage, 0...10 VDC, extended range
			000110	reserved
			000111	reserved
			001000	current, 0...20mA, standard
			001001	current, 4...20mA, standard
			001010	current, 0...20mA, NE 43
			001011	current, 4...20mA, NE 43
			001100	current, 0...20mA, extended range
			001101	current, 4...20mA, extended range
			001110	reserved
			001111	reserved
			010000	Pt 100, -200°C...850 °C, 2-wire
			010001	Pt 100, -200°C...150 °C, 2-wire
			010010	Pt 200, -200°C...850 °C, 2-wire
			010011	Pt 200, -200°C...150 °C, 2-wire
			010100	Pt 500, -200°C...850 °C, 2-wire
			010101	Pt 500, -200°C...150 °C, 2-wire
			010110	Pt 1000, -200°C...850 °C, 2-wire
			010111	Pt 1000, -200°C...150 °C, 2-wire
			011000	Pt 100, -200°C...850 °C, 3-wire **B**
			011001	Pt 100, -200°C...150 °C, 3-wire **B**
			011010	Pt 200, -200°C...850 °C, 3-wire **B**
			011011	Pt 200, -200°C...150 °C, 3-wire **B**
			011100	Pt 500, -200°C...850 °C, 3-wire **B**
			011101	Pt 500, -200°C...150 °C, 3-wire **B**

Table 5-22: Module parameters

Byte	Bit	Parameter name	Value	Meaning
		Operation mode Kx	011110	Pt 1000, -200°C...850 °C, 3-wire **B**
			011111	Pt 1000, -200°C...150 °C, 3-wire **B**
			100000	Ni 100, -60 °C...250 °C, 2-wire
			100001	Ni 100, -60°C...150 °C, 2-wire
			100010	Ni 1000, -60 °C...250 °C, 2-wire
			100011	Ni 1000, -60°C...150 °C, 2-wire
			100100	Ni 1000TK5000, -60 °C...250 °C, 2-wire
			100101	reserved
			100110	reserved
			100111	reserved
			101000	Ni 100, -60 °C...250 °C, 3-wire **B**
			101001	Ni 100, -60°C...150 °C, 3-wire **B**
			101010	Ni 1000, -60 °C...250 °C, 3-wire **B**
			101011	Ni 1000, -60°C...150 °C, 3-wire **B**
			101100	Ni 1000TK5000, -60 °C...250 °C, 3-wire **B**
			101101	reserved
			101110	reserved
			101111	reserved
			110000	resistance, 0...250 Ω
			110001	resistance, 0...400 Ω
			110010	resistance, 0...800 Ω
			110011	resistance, 0...2000 Ω
			110100	resistance, 0...4000 Ω
			110101 to 111110	reserved
			111111	channel not active
	6	Value repre-sentation Kx	0	Integer (15 bit + sign) **A**
			1	12 bit (left justified)
	7	Diagnostics Kx	0	release **A**
			1	block

5.13.3 Analog output modules

- BL20-1AO-I(0/4...20MA) (3 byte per channel)

Table 5-23: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value – Meaning
0	0	current mode	0 = 0...20 mA **A**
			1 = 4...20 mA
	1	value representation	0 = Integer (15 bit + sign) **A**
			1 = 12 bit (left justified)
	2 to 7	reserved	
1		substitute value low byte	The substitute value will be transmitted if the respective parameters of the gateway have been set to "output substitute value".
2		substitute value high byte	

- BL20-2AO-I(0/4...20MA) (3 byte per channel)

Table 5-24: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value – Meaning
0	0	current mode	0 = 0...20 mA **A**
			1 = 4...20 mA
	1	value representation	0 = Integer (15 bit + sign) **A**
			1 = 12 bit (left justified)
	2	reserved	
	3	channel	0 = activate **A**
			1 = deactivate
	4 to 7		
1		substitute value low byte	The substitute value will be transmitted if the respective parameters of the gateway have been set to "output substitute value".
2		substitute value high byte	

- BL20-2AO-U(-10/0...+10VDC) (3 byte per channel)

Table 5-25: Module parameters

A *Default-settings*

Byte	**Bit**	**Parameter name**	**Value – Meaning**
0	0	voltage mode	0 = 0...10 V **A**
			1 = -10...+10 V
	1	value representation	0 = Integer (15 bit + sign) **A**
			1 = 12 bit (left justified)
	2	reserved	
	3	channel	0 = activate **A**
			1 = deactivate
	4 to 7	reserved	
1		substitute value low byte	The substitute value will be transmitted if the respective parameters of the gateway have been set to "output substitute value".
2		substitute value high byte	

- BL20-2AOH-I

Table 5-26: Module parameters

A *Default settings*

Byte	**Bit**	**Parameter name**	**Value**
0 (channel 1)	0	Channel	0 = activate **A**
			1 = deactivate
	1	Diagnostics	0 = block
			1 = release **A**
	3 + 4	Operation mode	0 = 0… 20 mA (HART®-status polling not possible)
			1 = 4…20 mA (HART®-status polling not possible)
			2 = 4…20 mA HART® aktiv **A** Cyclic polling of the HART®-Status is activated.
	7	HART®-diagnostic	0 = release **A**
			1 = block

Table 5-26: Module parameters

A *Default settings*

Byte	Bit	Parameter name	Value
1 (channel 1)	0+1	Value representation	0 = Integer (15 bit + sign)**A**
			1 = NE 43
			2 = Extended Range
	6 + 7	Behavior module bus error	In Modbus TCP, the output of a substitute value in case of an error is not possible
2 + 3 (channel 1)		Substitute value	
4 to 7 (channel 2)	analog to bytes 0 to 3		
8	HART®-variable A		Defines the channel from which the HART®-variable is read.
	0	Mapped channel Vx	0 = channel 1
			1 = channel 2
	6 + 7	Mapped variable Vx	Defines which HART®-variable of the connected sensor is mapped into the module's process data.
			0 = PV (primary variable)
			1 = SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)
9	HART®-variable B		Defines the channel from which the HART®-variable is read.
	0	Mapped channel Vx	0 = channel 1
			1 = channel 2
	6 + 7	Mapped variable Vx	Defines which HART®-variable of the connected sensor is mapped into the module's process data.
			0 = PV (primary variable)
			1 = SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)

Table 5-26: Module parameters

A *Default settings*

Byte	Bit	Parameter name	Value
10	HART®-variable C		Defines the channel from which the HART®-variable is read.
	0	Mapped channel Vx	0 = channel 1
			1 = channel 2
	6 + 7	Mapped variable Vx	Defines which HART®-variable of the connected sensor is mapped into the module's process data.
			0 = PV (primary variable)
			1 = SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)
11	HART®-variable D		Defines the channel from which the HART®-variable is read.
	0	Mapped channel Vx	0 = channel 1
			1 = channel 2
	6 + 7	Mapped variable Vx	Defines which HART®-variable of the connected sensor is mapped into the module's process data.
			0 = PV (primary variable)
			1 = SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)

- BL20-E-4AO-U/I (3 byte per channel)

Table 5-27: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value	Meaning
0/3/6/9	0 to 3	Operation mode Kx	0000	voltage, -10...10 V DC, standard **A**
			0001	voltage, 0...10 V DC, standard
			0010	voltage, -10...10 V DC, PA NE 43
			0011	voltage, 0...10 V DC, PA NE 43
			0100	voltage, -10...10 V DC, extended range
			0101	voltage, 0...10 V DC, extended range
			0110	reserved
			0111	reserved
			1000	current, 0...20mA, standard
			1001	current, 4...20mA, standard
			1010	current, 0...20mA, NE 43
			1011	current, 4...20mA, NE 43
			1100	current, 0...20mA, extended range
			1101	current, 4...20mA, extended range
			1110	reserved
			1111	channel not active
	4	Value representation Kx	0	Integer (15 bit + sign) **A**
			1	12 bit (left justified)
	5	Diagnostics Kx	0	release **A**
			1	block
	6 + 7	Substitute value options Ax	00	output substitute value **A**
			01	hold current value
			10	output min. value
			11	output max. value
1/4/7/10		substitute value Ax LOW-byte	In Modbus TCP, the output of a substitute value in case of an error is not possible	
2/5/8/11		substitute value Ax HIGH-byte		

5.13.4 Technology modules

- BL20-1CNT, Counter mode

Table 5-28: Module parameters

A *Default settings*

Byte	Bit	Parameter name	Value – Meaning
0	0 to 5	Counter mode	100000 = continous count**A** 100001 = single-action count 100010 = periodical count
1	0	gate function	0 = abort count procedure **A** 1 = interrupt count procedure
	1	digital input DI	0 = normal **A** 1 = inverted
	2/ 3	Function DI	00 = input **A** 01 = HW-gate 10 = Latch-retrigger when edge positive 11 = Synchronization when edge positive
	4	Synchronization	0 = single-action**A** 1 = periodical
	5/6	Main count direxion	00 = none **A** 01 = up 10 = down
2 to 5		Lower count limit	-2 147 483 648 (-2^{31}) to 0
		Lower count limit (HWORD)	-32768 **A** to 0 (Signed16)
		Lower count limit (LWORD)	-32 768 to 32 767 (Signed16); 0 **A**
6 to 9		Upper count limit	0 to + 2147483647 (2^{31}-1)
		Upper count limit (HWORD)	0 to 32767 **A** (Unsigned16)
		Upper count limit (LWORD)	0 to 65535 **A** (Unsigned16)
10		Hysteresis	0 **A** to 255 (Unsigned8)
11		pulse duration DO1, DO2 [n*2ms]	0 **A** to 255 (Unsigned8)

Table 5-28: Module parameters

A *Default settings*

Byte	Bit	Parameter name	Value – Meaning
12	0	Substitute value DO	0 **A** 1
	1	Diagnostic DO1	0 = on **A** 1 = off
	2/ 3	Function DO1	00 = output **A** 01 = on when cnt value >= ref. value 10 = on when cnt value <= ref. value 11 = pulse when cnt val. = ref. value
	5/ 6	Function DO2	00 = output **A** 01 = on when cnt value >= ref. value 10 = on when cnt value <= ref. value 11 = pulse when cnt val. = ref. value
13	0/ 1	Signal evaluation (A,B)	00 = pulse and direction **A** 01 = rotary sensor: single 10 = rotary sensor: double 11 = rotary sensor: fourfold
	2	Sensor/ input filter (A)	0 = 2,5 µs(200kHz) **A** 1 = 25 µs(20kHz)
	3	Sensor/ input filter (B)	0 = 2,5 µs(200kHz) **A** 1 = 25 µs(20kHz)
	4	Sensor/ input filter (DI)	0 = 2,5 µs(200kHz) **A** 1 = 25 µs(20kHz)
	5	Sensor (A)	0 = normal **A** 1 = inverted
	7	Direction input (B)	0 = normal **A** 1 = inverted
14	0	Group diagnostics	0 = release **A** 1 = block
	4/ 5	Behavior CPU/master STOP	– 00 = switch off DO1 **A** – 01 = proceed with operating mode – 10 = DO1 switch to substitute value – 11 = DO1 hold last value

- BL20-1CNT-24VDC, measurement mode

Table 5-29: Module parameters

A *Default settings*

Byte	Bit	Parameter name	Value – Meaning
0	0 to 5	Measurement mode	100000 = frequency measurement**A** 100001 = revolutions measurement 100010 = period duration measurement
1	0	Digital input DI	0 = normal **A** 1 = inverted
	1	Function DI	0 = input **A5** 1 = HW gate
2 to 4		Lower limit	0 to 16 777 214 x 10^{-3}
		Lower limit (HWORD)	0 **A** to 255 (Unsigned8)
		Lower limit (LWORD)	0 **A** to 65535
5 to 7		Upper limit	1 to 16 777 215 x 10^{-3}
		Upper limit (HWORD)	0 **A** to 255 (Unsigned8)
		Upper limit (LWORD)	0 **A** to 65535
8 to 9		Integration time [n*10ms]	1 to 1 000; 10 **A**
10 to 11		Sensor pulse per revolution	1**A** to 65535
12	0	Substitute value DO1	0 **A** 1
	1	Diagnostic DO1	0 = on **A** 1 = off
12	2/ 3	Function DO1	00 = output **A** 01 = outside of limit 10 = below lower limit 11 = above upper limit
13	0/ 1	Signal evaluation (A,B)	00 = pulse and direction**A** 01 = rotary sensor: single
	2	Sensor/ input filter (A)	0 = 2,5 µs (200kHz) **A** 1 = 25 µs(20kHz)
	3	Sensor/ input filter (B)	0 = 2,5 µs(200kHz) **A** 1 = 25 µs(20kHz)
	4	Sensor/input filter (DI)	0 = 2,5 µs(200kHz) **A** 1 = 25 µs(20kHz)

Table 5-29: Module parameters

A *Default settings*

Byte	Bit	Parameter name	Value – Meaning
13	5	Sensor (A)	0 = normal **A** 1 = inverted
	7	Direction input (B)	0 = normal **A** 1 = inverted
14	0	Group diagnostics	0 = release **A** 1 = block
	4/ 5	Behaviour CPU/master STOP	00 = turn off DO1 **A** 10 = proceed with operating mode 01 = DO1 switch to substitute value 11 = DO1 hold last value

- BL20-1RS232

Table 5-30: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value – Meaning
0	3 to 0	data rate	0000 = 300 bps 0001 = 600 bps 0010 = 1200 bps 0100 = 2400 bps 0101 = 4800 bps 0110 = 9600 bps **A** 0111 = 14400 bps 1000 = 19200 bps 1001 = 28800 bps 1010 = 38400 bps 1011 = 57600 bps 1100 = 115200 bps ... reserved
	5,4	reserved	-
	6	Disable ReducedCtrl	Constant setting: – The diagnosis messages are set in Byte 6 of the process input data (independent of "diagnostic"). Byte 6 of the process output data contains two bits which may set to flush the transmit- or the receive-buffer. – Byte 7 contains the status- or the control-byte. – Bytes 0 to 5 contain the user data.
	7	diagnosis	0 = release **A**
			1 = block
1	0	stop bits	0 = 1 bit **A**
			1 = 2 bit
	2,1	parity	00 = none
			01 = odd **A** – The number of the bits set (data bits and parity bit) is odd.
			10 = even – The number of the bits set (data bits and parity bit) is even.
	3	data bits	0 = 7 **A** – The number of data bits is 7.
			1 = 8 – The number of data bits is 8.

Table 5-30: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value – Meaning
1	5,4	data flow control	00 = none **A** – the data flow control is deactivated
			01 = XON/XOFF – Software-Handshake (XON/XOFF) is activated
			10 = RTS/CTS – Hardware-Handshake (RTS/CTS) is activated.
	7,6	reserved	
2		XON-character	This character is used to start the data transfer of the data terminal device (DTE) when the software-handshake is activated
3		XOFF-character	This character is used to stop the data transfer of the data terminal device (DTE) when the software-handshake is activated

- BL20-1RS485/422

Table 5-31: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value – Meaning
0	3 to 0	data rate	0000 = 300 bps 0001 = 600 bps 0010 = 1200 bps 0100 = 2400 bps 0101 = 4800 bps 0110 = 9600 bps **A** 0111 = 14400 bps 1000 = 19200 bps 1001 = 28800 bps 1010 = 38400 bps 1011 = 57600 bps 1100 = 115200 bps ... reserved
	4	Select RS485	0 = – parameterization as RS4222
			1 = – parameterization as RS485
	5	reserved	
	6	Disable ReducedCtrl	Constant setting: – The diagnosis messages are set in Byte 6 of the process input data (independent of "diagnostic"). Byte 6 of the process output data contains two bits which may set to flush the transmit- or the receive-buffer. – Byte 7 contains the status- or the control-byte. – Bytes 0 to 5 contain the user data.
	7	diagnosis	0 = release **A**
			1 = block
1	0	stop bits	0 = 1 bit **A**
			1 = 2 bit
	2,1	parity	00 = none
			01 = odd **A** – The number of the bits set (data bits and parity bit) is odd.
			10 = even – The number of the bits set (data bits and parity bit) is even.

Table 5-31: Module parameters **A** *Default-settings*	**Byte**	**Bit**	**Parameter name**	**Value** **– Meaning**
	1	3	data bits	0 = 7 **A** – The number of data bits is 7.
				1 = 8 – The number of data bits is 8.

- BL20-1SSI

Table 5-32: Module parameters **A** *Default-settings*	**Byte**	**Bit**	**Parameter name**	**Value** **– Meaning**
	0	4 to 0	reserved	
		5	Encoder data cable test	0 = activate **A** – ZERO test of data cable.
				0 = deactivate – After the last valid bit, a ZERO test of the data cable is not carried out.
		7,6	reserved	
	1	3 to 0	Number of invalid bits (LSB)	0000 to 1111: Number of invalid bits on the LSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows: SSI_FRAME_LEN -INVALID_BITS_MSB - INVALID_ BITS_LSB. The invalid bits on the LSB side are removed by shifting the position value to the right, starting with the LSB.(Default 0 bit = 0×0). INVALID_BITS_MSB +INVALID_BITS_LSB must always be less than SSI_FRAME_LEN.

Table 5-32: Module parameters

A *Default-settings*

Byte	Bit	Parameter name	Value – Meaning
1	6 to 4	Number of invalid bits (MSB)	Number of invalid bits on the MSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows: SSI_FRAME_LEN -INVALID_BITS_MSB - INVALID_BITS_LSB. The invalid bits on the MSB side are zeroed by masking the position value. INVALID_BITS_MSB + INVALID_BITS_LSB must always be less than SSI_FRAME_LEN. Default: 0 = 0hex
	7	reserved	
2	3 to 0	data rate	0000 = 1000000 bps 0001 = 500000 bps **A** 0010 = 250000 bps 0011 = 125000 bps 0100 = 100000 bps 0101 = 83000 bps 0110 = 71000 bps 0111 = 62500 bps ... reserved
	7 to 4	reserved	
3	5 to 0	data frame bits	00000 to 100000 Number of bits of the SSI data frame. SSI_FRAME_LEN must always be greater than INVALID_BITS. Default: 25 = 19hex
	6	reserved	
	7	data format	binary coded **A** – SSI encoder sends data in binary code
			GRAY coded – SSI encoder sends data in Gray code

- BL20-E-1SWIRE

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	reserved	free	free	MC	MNA	Configura-tion	Disable Cfg	free
Byte 2	free	U_{AUXERR}	TYP_{ERR}	TYP_{INFO}	PKZ_{ERR}	PKZ_{INFO}	SD_{ERR}	SD_{INFO}
Byte 3	reserved							
Byte 4	reserved (lifeguarding time up to version VN 01-03)							
Byte 5	$SC_{DIAG}S8$	$SC_{DIAG}S7$	$SC_{DIAG}S6$	$SC_{DIAG}S5$	$SC_{DIAG}S4$	$SC_{DIAG}S3$	$SC_{DIAG}S2$	$SC_{DIAG}S1$
Byte 6	$SC_{DIAG}S16$	$SC_{DIAG}S15$	$SC_{DIAG}S14$	$SC_{DIAG}S13$	$SC_{DIAG}S12$	$SC_{DIAG}S11$	$SC_{DIAG}S10$	$SC_{DIAG}S9$
Byte 7	reserved							
Byte 8	reserved							
Byte 9 - 24	Type designation slave 1 - 16							

The following table shows the meaning of the parameter bits:

Table 5-33: Module parameters

A *Default-settings*

Parameter name	**Value**	
Byte 1		
Disable Cfg	If the physical structure of the SWIRE bus does not match the configuration stored in the BL20-E-1SWIRE on power up (SW LED flashing), the physical structure of the SWIRE bus must be stored in the BL20-E-1SWIRE.	
	0 = inactive **A**	Manual SWIRE configuration: To store the physical structure of the SWIRE bus in the BL20-E-1SWIRE, the CFG button of the BL20-E-1SWIRE must be pressed manually (only functions if the SW LED is flashing).
	1 = active	Automatic SWIRE configuration: If the physical structure of the SWIRE bus does not match the configuration stored in the BL20-E-1SWIRE on power up, the physical structure is stored automatically in the BL20-E-1SWIRE.
Configura-tion	PLC configuration check If the PLC configuration check is activated, the configuration stored in the BL20-E-1SWIRE is compared with the SET configuration stored in the PLC.	
	0 = active **A**	The configuration stored in BL20-E-1SWIRE is compared with the SET configuration stored in the PLC. Only SWIRE slaves in the SWIRE bus are accepted that have a device ID completely matching the SET configuration.
	1 = inactive	All slaves are mapped in 4Bit INPUT / 4Bit OUTPUT without checking the device ID.

Table 5-33: Module parameters

Parameter name	Value	
Byte 1		
MNA active/ passive	Configuration check Bus or slave-oriented configuration check (without function if MC = 1)	
	0 = bus based **A**	If the PLC configuration check is activated, data exchange is only started if the configuration stored in the BL20-E-1SWIRE fully matches the SET configuration stored in the PLC. Modifying the bus during operation causes the system to be aborted.
	1 =slave based	If the PLC configuration check is activated, data exchange is started with all SWIRE slaves that match the SET configuration stored in the PLC. The SWIRE slaves that do not match the SET configuration stored in the PLC do not perform any data exchange.
MC	Moeller conformance (from version VN 01-04) Behavior of the BL20-E-1SWIRE in accordance with SWIRE Conformance criteria.	
	0 = inactive **A**	Default behavior
	1 = active	The BL20-E-1SWIRE master responds according to the Moeller SWIRE Conformance criteria (see manual for the IO-modules D300717).
SD_{INFO}	Slave error field Activate slave diagnostics info field $SD_{ERR}Sx$. As soon as a slave on the bus sets its error bit, this is indicated individually as an error depending on the parameter setting.	
	0 = active	Single diagnostics is activated
	1 = inactive	Single diagnostics is not activated
Byte 2		
SD_{ERR}	Group error - slave error Activate slave diagnostics $SD_{ERR}Sx$. As soon as only one slave on the bus sets its error bit, this is indicated as a group error depending on the parameter setting.	
	0 = active **A**	Group diagnostics is activated
	1 = inactive	Group diagnostics is not activated
PKZ_{INFO}	PKZ error field Activate slave diagnostics info field $PKZ_{ERR}Sx$. As soon as a SWIRE-DIL slave on the bus clears its PKZ bit, this is indicated as an individual error depending on the parameter setting.	
	0 = active **A**	Single diagnostics is activated
	1 = inactive	Single diagnostics is not activated

Table 5-33: Module parameters

Parameter name	Value	
Byte 2		
PKZ_{ERR}	Group PKZ error field Activate slave diagnostics PKZ_{ERR}Sx. As soon as only one SWIRE-DIL slave on the bus clears its PKZ bit, this is indicated as an error depending on the parameter setting.	
	0 = active **A**	Group diagnostics is activated
	1 = inactive	Group diagnostics is not activated
TYP_{INFO}	Configuration error field As soon as a slave on the bus does not match the set configuration and therefore cannot be started, this is indicated as an individual error depending on the parameter set.	
	0 = active **A**	Single diagnostics is activated
	1 = inactive	Single diagnostics is not activated
TYP_{ERR}	Group configuration error field Activate slave diagnostics $TYPE_{ERR}$Sx. As soon as only one slave on the bus is incorrectly configured, this is indicated as an error depending on the parameter setting.	
	0 = active **A**	Group diagnostics is activated
	1 = inactive	Group diagnostics is not activated
U_{AUXERR}	Error message -U_{AUX}- Activate system diagnostics U_{AUXERR}. U_{AUXERR} will generate an error message as soon as the power supply goes below a level at which the function of the relays is not guaranteed.	
	0 = active **A**	Error message U_{AUXERR} activated
	1 = inactive	Error message U_{AUXERR} not activated
Byte 3	reserved	
Byte 4		
reserved (Lifeguarding time only up to version VN01-03)	Was up to version VN 01-03: Lifeguarding time of the SWIRE slaves.	
	0x02-0xFF 0x64 **A**	Lifeguarding time of the SWIRE slaves Setting of lifeguarding time, timeout time up to automatic reset of the slaves in the event of communication failure. (n ∞ 10ms) (Default 1s) 0xFF: Lifeguarding off
Byte 5, 6		
SD_{DIAG}Sx	Input bit communication error, slave x Slave diagnostics message from Byte 1 / Bit 7 is accepted in the feedback interface as Bit4	
	0 = active **A**	SD_{DIAG}Sx is accepted
	1 = inactive	SD_{DIAG}Sx is not accepted
Byte 7, 8	reserved	

Table 5-33: Module parameters

Parameter name	Value	
Byte 9 bis 24		
Device ID, slave x	TYPE setting for the LIN slave at position x on the SWIRE bus	
	0x20	SWIRE-DIL-MTB (: 0xFF)
	0xFF	Basic setting (no slave)

- BL20-E-2CNT-2PWM (see separate module-manual D301224)
- BL20-2RFID-S (see RFID-documentation www.turck.de)

5.14 Diagnostic Messages of the Modules

5.14.1 Power Supply Modules

- BL20-BR-24VDC-D

Table 5-34: BL20-BR-24VDC-D

Diagnostic byte	Bit	Diagnostics
n	0	Module bus undervoltage warning
	1	reserved
	2	Undervoltage field supply
	3	reserved

- BL20-PF-24VDC-D

Table 5-35: BL20-PF-24VDC-D

Diagnostic byte	Bit	Diagnostics
n	1	reserved
	2	reserved
	3	undervoltage field supply
	4	reserved

- BL20-PF-120/230VAC-D

Table 5-36: BL20-PF-120/230VAC-D

Diagnostic byte	Bit	Diagnostics
n	0	reserved
	1	reserved
	2	undervoltage field supply
	3	reserved

5.14.2 Digital Input Modules

- BL20-4DI-NAMUR

Table 5-37: BL20-4DI-NAMUR

Diagnostic byte	Bit	Diagnostics
n	0	short circuit sensor 1
	1	open circuit sensor 1
	2	short circuit sensor 2
	3	open circuit sensor 2
	4	short circuit sensor 3
	5	open circuit sensor 3
	6	short circuit sensor 4
	7	open circuit sensor 4

5.14.3 Analog Input Modules

- BL20-1AI-I(0/4...20MA)

Table 5-38: BL20-1AI-I(0/4...20MA)

Diagnostic byte	Bit	Diagnostics
n (channel 1)	0	measurement value range error **A**
	1	open circuit

A *Only in the measurement range 4 to 20 mA*

- BL20-2AI-I(0/4...20MA)

Table 5-39: BL20-2AI-I(0/4...20MA)

Diagnostic byte	Bit	Diagnostics
n (channel 1)	0	measurement value range error**A**
	1	open circuit
n + 1 (channel 2)	0	measurement value range error**A**
	1	open circuit

A *Only in the measurement range 4 to 20 mA*

- BL20-1AI-U(-10/0...+10VDC

Table 5-40: BL20-1AI-U (-10/0...+10VDC

Diagnostic byte	Bit	Diagnostics
n (channel 1)	0	measurement value range error

- BL20-2AI-U(-10/0...+10VDC)

Table 5-41: BL20-2AI-U (-10/0...+10VDC

Diagnostic byte	Bit	Diagnostics
n (channel 1)	0	measurement value range error
n (channel 2)	0	measurement value range error

- BL20-2AI-PT/NI-2/3

Table 5-42: BL20-2AI-PT/NI-2/3

Diagnostic byte	Bit	Diagnostics
n (channel 1)	0	Measurement value range error **A** (Underflow diagnostics in temperature measurement ranges only)
	1	Open circuit
	2	Short circuit **B** (in temperature measurement ranges only)
	3 to 7	reserved

A *threshold: 1% of the positive measurement range end value*
B *threshold: 5 Ω (loop resistance)*

- BL20-2AI-THERMO-PI

Table 5-43: BL20-2AI-THERMO-PI

Diagnostic byte	Bit	Diagnostics
n	0	measurement value range error **A**
	1	open circuit (only in temperature measurement ranges)
	2 to 7	reserved

A *threshold: 1% of the positive measurement range end value*

- BL20-2AIH-I

Table 5-44: BL20-2AIH-I

Diagnosis byte	Bit	Diagnosis
n	0	Overflow The measured value exceeds the upper measurement range and the module can not process the value.
	1	Wire break Shows a wire break in the signal line.
	2	Short-circuit Shows a short-circuit in the signal line
	3	Underflow The measured value is lower than the lower measurement range and the module can not process the value.
	4	HART® status-error The connected HART®-device set a bit in the HART® status-information ("status - polling").
	5	HART® communication error The channel does not allow communication with the HART®-device.
	6	Invalid value
	7	Hardware error Shows common errors of the module hardware. The return analog value in case of an error is "0".

- BL20-4AI-U/I

Table 5-45: BL20-4AI-U/I

Diagnostic byte	Bit	Diagnostics
n (ch.0) to n + 3 (ch. 3)	0	measurement value range error **A**
	1	open circuit **B**
	2 to 7	reserved

A *threshold: 1% of the positive measurement range end value, underflow diagnosis only in value range 4...20 mA*

B *threshold: 3 mA (only in value range 4...20 mA)*

- BL20-8AI-U/I-4PT/NI

Table 5-46: BL20-8AI-U/I-4AI-PT/NI

Diagnosis byte	Bit	Diagnosis
n (channel 0) to n + 7 (channel 7)	0	measurement value range error (OoR) **A**
	1	wire break (WB) **A**
	2	short-circuit (SC) **A**
	3	overflow / underflow (OUFL) **A**
	4 to 6	reserved
	7	hardware error

A *thresholds: value representation of the module in manual D300716*

5.14.4 Digital Output Modules

- BL20-2DO-24VDC-0.5A-P

Table 5-47: BL20-2DO-24VDC-0.5A-P

Diagnostic byte	Bit	Diagnostics
n	0	overcurrent (short-circuit channel 1)
	1	overcurrent (short-circuit channel 2)

- BL20-2DO-24VDC-0.5A-N

Table 5-48: BL20-2DO-24VDC-0.5A-N

Diagnostic byte	Bit	Diagnostics
n	0	overcurrent (short-circuit channel 1)
	1	overcurrent (short-circuit channel 2)

- BL20-2DO-24VDC-2A-P

Table 5-49: BL20-2DO-24VDC-2A-P

Diagnostic byte	Bit	Diagnostics
n	0	overcurrent (short-circuit channel 1)
	1	overcurrent (short-circuit channel 2)

- BL20-4DO-24VDC-0.5A-P

Table 5-50: BL20-4DO-24VDC-0.5A-P

Diagnostic byte	Bit	Diagnostics
n	0	overcurrent /short-circuit (1 ch. min)

- BL20-16DO-24VDC-0.5A-P

Table 5-51: BL20-16DO-24VDC-0.5A-P

Diagnostic byte	Bit	Diagnostics
n	0	Overcurrent (short-circuit channel 1-4)
	1	Overcurrent (short-circuit channel 5-8)
	2	Overcurrent (short-circuit chnnel 9-12)
	3	Overcurrent (short-circuit channel 13-16)

- BL20-32DO-24VDC-0.5A-P

Table 5-52: BL20-32DO-24VDC-0.5A-P

Diagnostic byte	Bit	Diagnostics
n	0	Overcurrent (short-circuit channel 1-4)
	1	Overcurrent (short-circuit channel 5-8)
	2	Overcurrent (short-circuit chnnel 9-12)
	3	Overcurrent (short-circuit channel 13-16)
	4	Overcurrent (short-circuit channel 17-20)
	5	Overcurrent (short-circuit channel 21-24)
	6	Overcurrent (short-circuit chnnel 25-28)
	7	Overcurrent (short-circuit channel 29-32)

5.14.5 Analog output modules

- BL20-2AOH-I

Table 5-53: BL20-2AOH-I

Diagnosis byte	Bit	Diagnosis
n	0	Value above upper limit Display of a measurement range exceeding → limit values according to parameterization
	1	Wire break Shows a wire break in the signal line.
	2	Invalid value The output value exceeds the values which the module is able to interpret.
	3	Value below lower limit Display of a measurement value underflow.→ limit values according to parameterization
	4	HART® status-error The connected HART®-device set a bit in the HART® status-information ("status - polling").
	5	HART® communication error The channel does not allow communication with the HART®-device.
	6	Invalid Parameter
	7	Hardware error Shows common errors of the module hardware. The return analog value in case of an error is "0".

- BL20-E-4AO-U/I

Table 5-54: BL20-4AO-U/I

A *thresholds: value representation of the module in manual D300716*

Diagnosis byte	Bit	Diagnosis
n (channel 0) to n + 3 (channel 3)	0	measurement value range error (OoR) **A**
	1	reserved
	2	reserved
	3	overflow / underflow (OUFL) **A**
	4 to 6	reserved
	7	hardware error

5.14.6 Technology Modules

- BL20-1CNT-24VDC

Table 5-55: BL20-1CNT-24VDC

Diagnostic byte	Bit	Diagnostics
n If bit 7 = 0 (counter mode)	0	Short-circuit / open circuit → ERR_DO
	1	Short-circuit in sensor power supply → ERR-24VDC
	2	End of counter range wrong
	3	Start of counter range wrong
	4	Invert-DI+latch-retr. not perm. It is not permitted to invert the level of the digital input when using the latch-retrigger-function
	5	Main count direction wrong
	6	Operating mode wrong
	7	Measurement mode Bit = 0 Conter mode active
n If bit 7 = 1 (Measure-ment mode)	0	Short-circuit / open circuit → ERR_DO
	1	Short-circuit in sensor power supply → ERR-24VDC
	2	Sensor pulse wrong
	3	Integration time wrong
	4	Upper limit wrong
	5	Lower limit wrong
	6	Operating mode wrong
	7	Messbetriebsart Bit = 1 measurement operation is active

- BL20-1RS232

Table 5-56: BL20-1RS232

Diagnostic byte	Bit	Diagnostics
n	0	parameterization error
	1	hardware failure
	2	data flow control error
	3	frame error
	4	buffer overflow

- BL20-1RS485/422

Table 5-57: BL20-1RS485/422

Diagnostic byte	Bit	Diagnostics
n	0	parameterization error
	1	hardware failure
	2	data flow control error (only in RS422-mode)
	3	frame error
	4	buffer overflow

- BL20-1SSI

Table 5-58: BL20-1SSI

Diagnostic byte	Bit	Diagnostics
n	0	SSI group diagnostics
	1	open circuit
	2	sensor value overflow
	3	sensor value underflow
	4	parameterization error

- BL20-E-1SWIRE

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte n	$GENEAL_{ERR}$	U_{SWERR}	free	COM_{ERR}	free	RDY_{ERR}	free	SW_{ERR}
Byte n+1	free	U_{AUXERR}	TYP_{ERR}	free	PKZ_{ERR}	free	SD_{ERR}	free
TYP_{ERR} Field								
Byte n+2	$TYP_{ERR}S8$	$TYP_{ERR}S7$	$TYP_{ERR}S6$	$TYP_{ERR}S5$	$TYP_{ERR}S4$	$TYP_{ERR}S3$	$TYP_{ERR}S2$	$TYP_{ERR}S1$
Byte n+3	$TYP_{ERR}S16$	$TYP_{ERR}S15$	$TYP_{ERR}S14$	$TYP_{ERR}S13$	$TYP_{ERR}S12$	$TYP_{ERR}S11$	$TYP_{ERR}S10$	$TYP_{ERR}S9$
Slave Diagnostic								
Byte n+4	$SD_{ERR}S8$	$SD_{ERR}S7$	$SD_{ERR}S6$	$SD_{ERR}S5$	$SD_{ERR}S4$	$SD_{ERR}S3$	$SD_{ERR}S2$	$SD_{ERR}S1$
Byte n+5	$SD_{ERR}S16$	$SD_{ERR}S15$	$SD_{ERR}S14$	$SD_{ERR}S13$	$SD_{ERR}S12$	$SD_{ERR}S11$	$SD_{ERR}S10$	$SD_{ERR}S9$
PKZ Field								
Byte n+6	$PKZ_{ERR}S8$	$PKZ_{ERR}S7$	$PKZ_{ERR}S6$	$PKZ_{ERR}S5$	$PKZ_{ERR}S4$	$PKZ_{ERR}S3$	$PKZ_{ERR}S2$	$PKZ_{ERR}S1$
Byte n+7	$PKZ_{ERR}S16$	$PKZ_{ERR}S15$	$PKZ_{ERR}S14$	$PKZ_{ERR}S13$	$PKZ_{ERR}S12$	$PKZ_{ERR}S11$	$PKZ_{ERR}S10$	$PKZ_{ERR}S9$

The following table shows the meaning of the diagnostics bits:

Table 5-59: Meaning of diagnostics data bits

Designation	Value	Meaning
Byte 1		
SW_{ERR}	SWIRE MASTER	
	If the physical structure of the SWIRE bus does not match the configuration stored in the BL20-E-1SWIRE, this bit indicates an error.	
	0 Data exchange	The physical structure of the SWIRE bus was accepted and the SWIRE bus is in operation.
	1 Offline	The physical structure was not accepted, the SWIRE bus does not start operation (SW LED flashing).
RDY_{ERR}	PLC SLAVE	
	This bit indicates an error if the configuration stored in the BL20-E-1SWIRE does not match the SET configuration stored in the PLC.	
	0 OK	No error present. The SWIRE bus is ready for data exchange.
	1 Offline	The configuration stored in the BL20-E-1SWIRE was not accepted. The data exchange is prevented (RDY LED flashing).

Table 5-59: Meaning of diagnostics data bits

Designation	Value	Meaning
COM_{ERR}	Communication SWIRE	
	A communication error is present, such as a slave is no longer reached, its internal timeout has elapsed or communication is faulty. The master cannot carry out data exchange with at least one slave.	
	0 OK	Error
	1 faulty	No error.
U_{SWERR}	Voltage U_{SW}	
	Voltage fault in U_{SW}, voltage U (17 VDC) for supplying the SWIRE slaves	
	0 OK	No error present.
	1 Undervoltage	An error is present
$GENERAL_{ERR}$	Error message	
	The creation of a function block shows that systems / function blocks for the general checking of a slave for any diagnostics messages present only check the first byte.	
	0 None	No diagnostics message present
	1 Present	One/several diagnostics messages present
Byte 2		
SD_{ERR}	Communication SWIRE slave	
	If the parameter SD_{ERR} is set for group diagnostics, this bit indicates an error as soon as only one slave on the bus sets its SD_{ERR} error bit.	
	0 OK	No error is present or diagnostics function has been deactivated via the parameter setting.
	1 faulty	Error
PKZ_{ERR}	Overcurrent protective circuit-breaker	
	If the parameter PKZ_{ERR} is set for group diagnostics, this bit indicates an error as soon as only one PKZ of a slave has tripped.	
	0 OK	No PKZ has tripped or diagnostics function has been deactivated via the parameter setting.
	1 Tripping	At least one PKZ has tripped.

Table 5-59: Meaning of diagnostics data bits

Designation	Value	Meaning	
$TYPE_{ERR}$	Configuration		
	If the TYP_{ERR} parameter is set with group diagnostics in the parameter setting, this bit indicates an error as soon as a PLC configuration check detects differing slave numbers, types or position of an SWIRE slave.		
	0	OK	The PLC configuration check was positive (the configuration stored in the BL20-E-1SWIRE matches the SET configuration stored in the PLC) or the diagnostics function is deactivated via the parameter setting.
	1	faulty	A mismatch was determined in the PLC configuration check.
U_{AUXERR}	Voltage U_{AUX}		
	If the U_{AUXERR} parameter is activated, U_{AUXERR} will generate an error message as soon as the power supply goes below the level at which the function of the relays is not guaranteed.		
	0	OK	Contactor supply voltage is o.k. (> 20 VDC) or diagnostics function has been deactivated via this parameter.
	1	Undervoltage	Contactor supply voltage is not o.k. (< 18 VDC).
Byte 3,4			
$TYPE_{ERR}Sx$	Device configuration, slave x		
	Info field for the individual indication of a configuration error as error message. If the TYP_{INFO} parameter is set with individual diagnostics, the error is indicated in this bit field as soon as a PLC configuration check detects differing slave numbers, types or position of an SWIRE slave.		
	0	OK	No configuration error is present and the slave is in data exchange mode or diagnostics function has been deactivated via the parameter setting.
	1	Incorrect	No configuration error present and the slave is NOT in data exchange mode

Table 5-59: Meaning of diagnostics data bits

Designation	Value	Meaning
Byte 5,6		
$SD_{ERR}Sx$	Communication, slave x	
	Info field for the individual indication of slave offline or slave diagnostics as error message. The fault is indicated in this bit field if the parameter setting SDINFO is set with individual diagnostics.	
	0 OK	No error is present or diagnostics function has been deactivated via the parameter setting.
	1 Offline	The slave has set its diagnostics bit or the slave was in data exchange with the SWIRE master but is not any longer.
Byte 7,8		
$PKZ_{ERR}Sx$	Only SWIRE-DIL: Overcurrent protective circuit-breaker slave x	
	Info field for the individual indication of the tripping of a motor-protective circuit-breaker (PKZ) as error message. If the PKZ_{INFO} is set for single diagnostics, this bit field indicates the error as soon as the PKZ of the slave Sx has tripped.	
	0 OK	The PKZ of the slave has not tripped or diagnostics function has been deactivated via the parameter setting.
	1 Tripped	The PKZ of the slave has tripped.

Hinweis

The error messages $U_{AUX}ERR$, $TYPE_{ERR}$, $TYPE_{ERR}Sx$, PKZ_{ERR}, $PKZ_{ERR}Sx$, SD_{ERR} and $SD_{ERR}Sx$ can be deactivated via the parameter setting.

- BL20-E-2CNT-2PWM (see separate module-manual D301224)
- BL20-2RFID-S (see RFID-documentation www.turck.de)

6 Configuration of the BL20-PG-EN with CoDeSys

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6.1 General

This chapter describes the configuration of a BL20 station with the programmable BL20 gateway for Modbus TCP in CoDeSys (Controller Development System) from "3S - Smart Software Solutions GmbH" on the basis of an example.

6.1.1 System requirements

- Installation of CoDeSys (version 2.3.5.8)
- Installation of the BL20 target files "TSP_Turck_×××.zip" (can be downloaded from www.turck.com)

Figure 6-34: CoDeSys from 3S

CoDeSys
The IEC 61131-3 Programming System
Version 2.3.5.8 Build Dec 7 2005)
© Copyright 1994-2005 by 3S - Smart Software Solutions GmbH
Smart Software Solutions
3S - We software Automation.

6.2 Installation of the BL20 target files

Before configuring the BL20 station with CoDeSys and programming the BL20-PG-EN, the BL20 Target Support Package (short: targets) have to be installed.

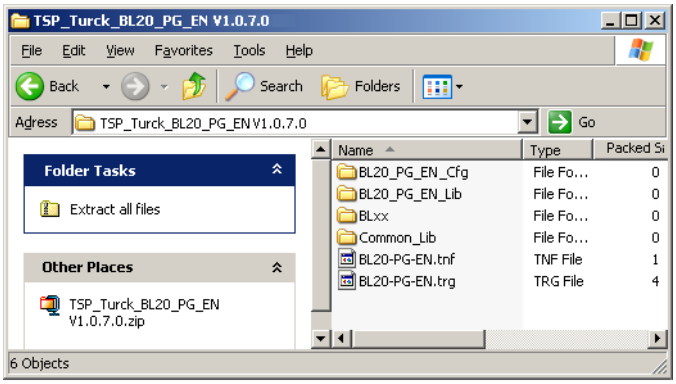
Target files contain all information necessary for integrating a system into the programming tool.

The Target Support Package (TSP) for the BL20-PG-EN can be downloaded from the TURCK homepage as a zipped archive (TSP_Turck_BL20_PG_EN ×××.zip).

This archive contains the target file and other manufacturer specific files like libraries etc. which are necessary for the operation of the gateway at CoDeSys.

The files have to be stored on your PC showing following directory structure:

Figure 6-35: Directory structure of the target file



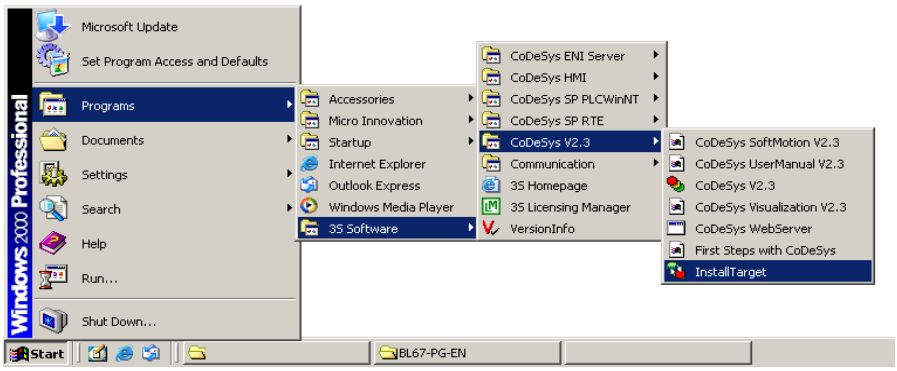
Note

Please observe, that the files have to be stored in this directory structure after having been extracted from the *.zip-file.
Otherwise, problems may occur during the target installation.

6.2.1 Installation

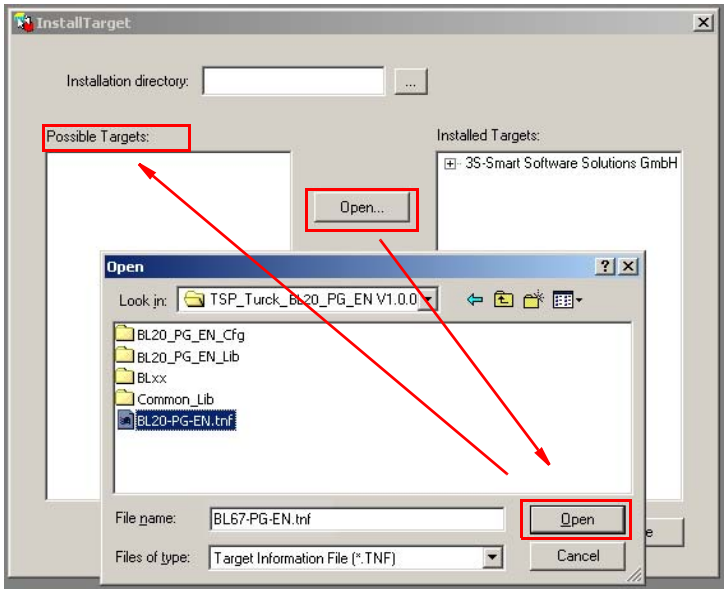
The target installation in CoDeSys is done using the "Start → Programs→ 3S Software → CoDeSys → V2.3 → Install Target"-command.

Figure 6-36: Install Target



Search the target information file "BL20-×××.tnf" using the "Open" button and add the TURCK gateways to "Possible Targets".

Figure 6-37: Select the target file



The BL20 target is installed using the "Install" button.

The BL20-PG-EN can now be found under "Installed Targets" and can be chosen in CoDeSys as a target now.

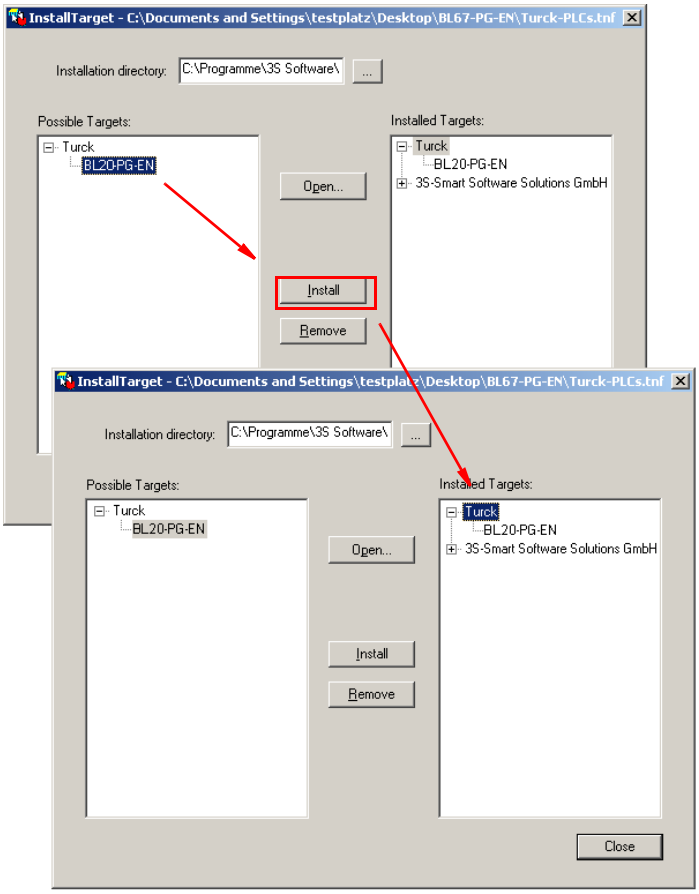


Figure 6-38: Installation of the TURCK target

6.3 BL20 Hardware Configuration

1. At first, configure your BL20 station (BL20-PG-EN and I/O modules) and switch on the power supply.
2. The gateway saves the actual station configuration, if the SET button under the cover on the gateway is pressed for approx. 10 seconds.
   The actual station configuration is now stored in the gateway as a reference module list.

Note

As soon as an application is loaded to the PG, the station configuration stored in the application is stored to the PG as reference module list.
IF no application is loaded to the PG, the SET button has to be pressed after every change in the station configuration.

3. The gateway now executes a reset.
4. If the "IO"-LED lights up green after the gateway's reset, the new station configuration has been successfully stored.

6.4 Configuration/ Programming of the PG in CoDeSys

6.4.1 Creating a new project

Start the Software an create a new project using the "File → New"-command.

Chose the BL20-PG-EN as target.

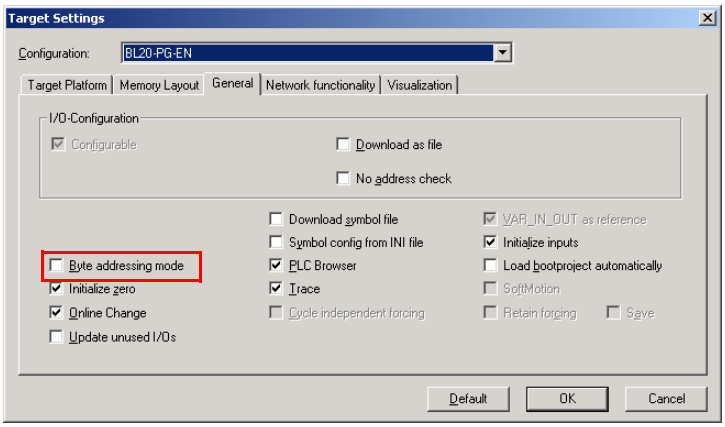
Normally, a further configuration of the gateway in the dialog box „target settings“ is not necessary.

Note

The BL20-PG-EN uses the word addressing mode (see the following table).
Please observe therefore, that the parameter "Byte addressing mode" in the "General" tab is always deactivated.

%IX**0**.0 - %IX**0**.7	%IX**0**.8 - %IX**0**.15	%IX**1**.0 - %IX**1**.7	%IX**1**.8 - %IX**1**.15	%IX**2**.0 - %IX**2**.7	%IX2.8 - %IX**2**.15	%IX**3**.0 - %IX**3**.7	%IX**3**.8 - %IX**3**.15	%IX**4**.0 - %IX**4**.7	%IX**4**.8 - %IX**4**.15	%IX**5**.0 - %IX**5**.7	%IX**5**.8 - %IX**5**.15
%IB0	%IB1	%IB2	%IB3	%IB4	%IB5	%IB6	%IB7	%IB8	%IB9	%IB10	%IB11
%IW**0**		%IW**1**		%IW**2**		%IW**3**		%IW**4**		%IW**5**	
%ID0				%ID1				%ID2			

Figure 6-39: Target settings



Pressing the "Ok" button created a new CoDeSys-project.

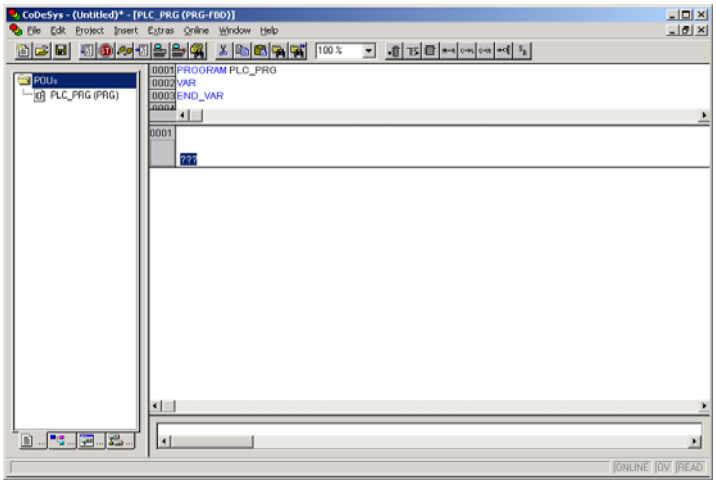
Attention

CoDeSys offers the possibility to control the processing of a project using the task management.

If no task configuration is defined, the project must contain a program named **PLC_PRG**.
The block PLC_PRG is automatically generated and is cyclically called by the runtime system.

PLC_PRG is always the main program in a Single-Task program.
If PLC_PRG is deleted or renamed, the project **must** be controlled using a task configuration.

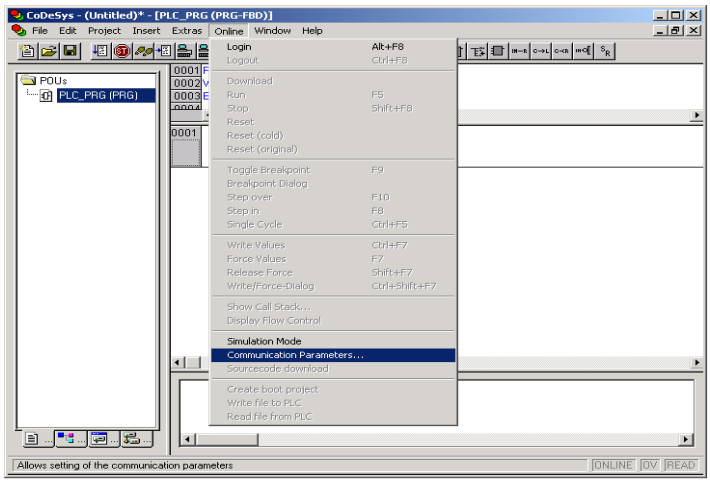
Figure 6-40: New CoDeSys-project



Now, the communication parameters for the target have to be adapted.

Communication parameters of the target

Figure 6-41: Opening the communication parameters



Mark "'localhost' via TCP/IP" in the „Channels“ field and define a new channel by pressing the „New“ button.

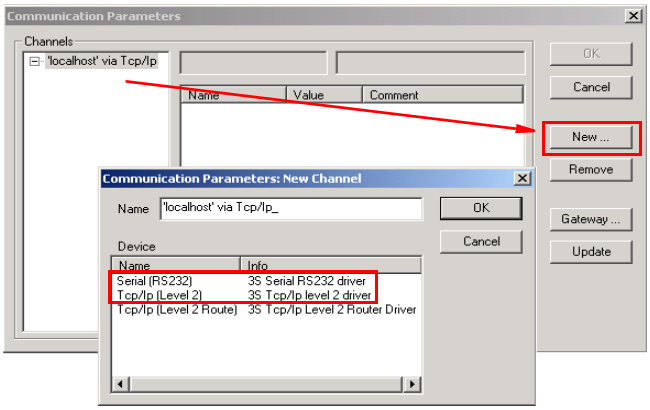
In the dialog box „Communication Parameters: New Channel“ the name for the new channel is edited and the communication interface is selected in the „Device“ field.

The BL20 gateway offers 2 possible communication interfaces:

1 PS/2 female connector for a serial RS232-communication

2 Ethernet connector (M12, 4-pole, D-coded) for a „TCP/IP (Level 2)"-communication.

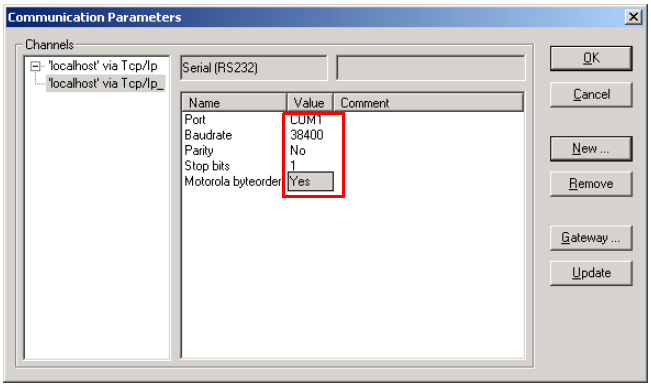
Figure 6-42: Defining a new channel



Select the preferred interface and set the parameters depending on the interface as follows:

1 serial RS232-communication:

Figure 6-43: Setting the communication parameters for RS232



Attention

The Parameter "Motorola byteorder" must be set to "YES". Otherwise, no error-free communication with the gateway is possible.

Please observe that the communication with the PG is only possible with a baudrate of 115200 Baud, when using the serial RS32-interface.

2 TCP/IP (Level 2)-communication

Adapt the gateway's communication parameters (IP address, Motorola byteorder) as shown in the following figure.

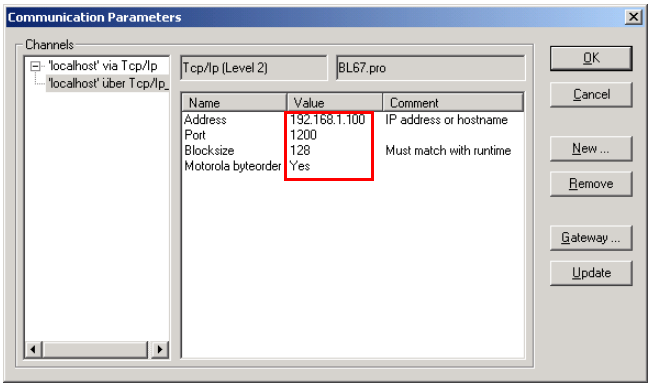


Figure 6-44: Setting the communication parameters for TCP/IP (Level 2)

Attention

The Parameter "Motorola byteorder" must be set to "YES". Otherwise, no error-free communication with the gateway is possible.

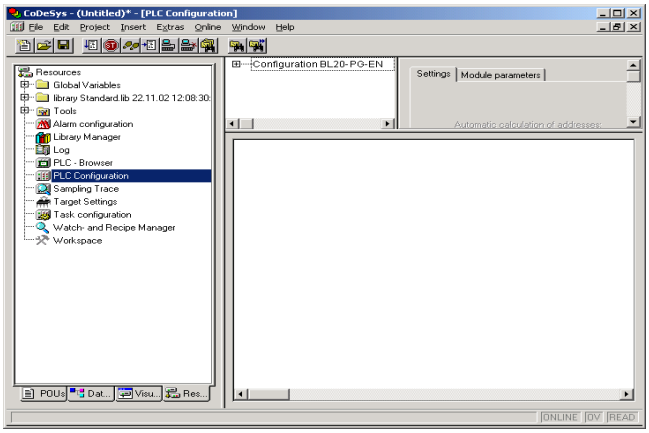
Note

When setting the IP address of the gateway, please observe that it has to match the settings of you PC network interface card. Otherwise, no communication can be built up between PC and PG (please read chapter 10, Network Configuration).

6.5 Configuration of the BL20 Station

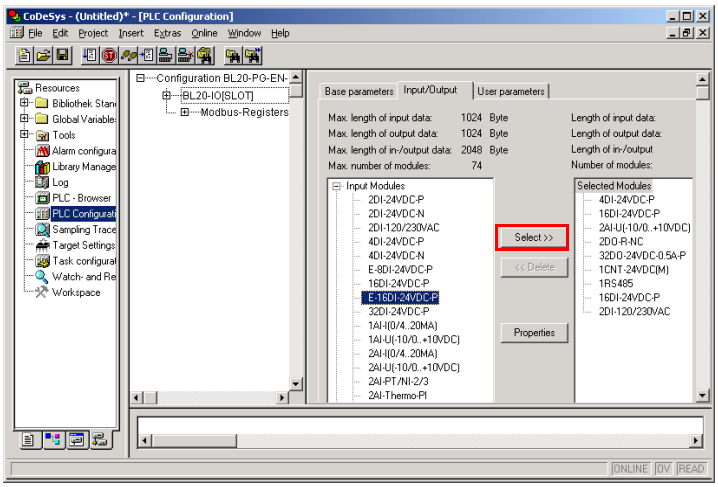
Open the „PLC Configuration“ in the „Resources“ tab.

Figure 6-45: PLC Configuration



Mark the BL20-IO[SLOT] and add the I/O modules to the gateway in the „Input/Output“ tab.

Figure 6-46: Selecting the I/O modules



Attention

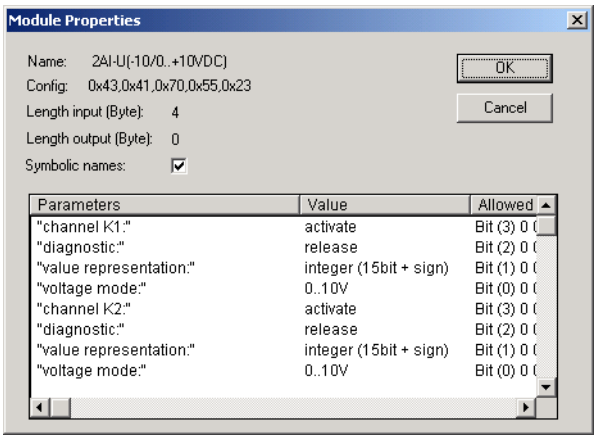
When configuring the BL20 station in the software, please observe that the order of the modules added to the gateway has to match the physical module order of the hardware configuration.

6.5.1 Parameterization of the I/O modules

For the parameterization of an I/O module mark the respective module in the „Selected Modules“ field and press the „Properties“ button.

In the „Module Properties“ dialog box each Parameter can be changed by double clicking the „Value“.

Figure 6-47: Parameterization of I/O modules



6.5.2 Addressing the in- and output data

In- and output addresses as well as diagnostic addresses are automatically assigned to the gateway and the connected modules.

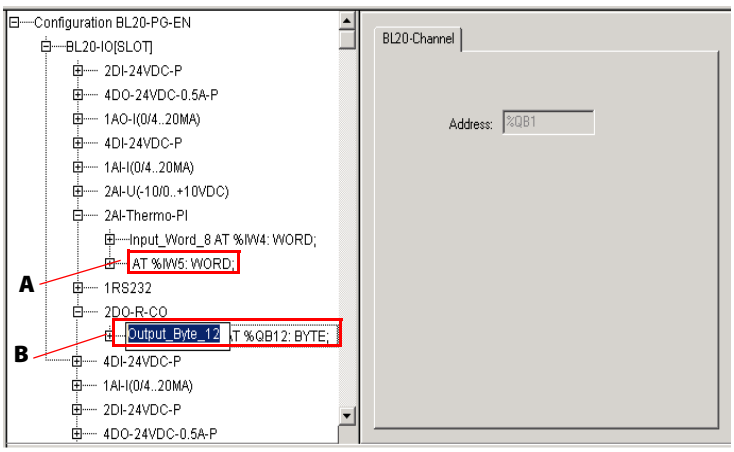
In addition to that, the gateway automatically receives a module ID as a unique identifier of the node within the entire configuration and a node number shows the gateway's position in the configuration structure.

Note

The assignment of the in- and output addresses is done automatically and cannot be changed by the user.
In case of configuration changes, this assignment is also adapted automatically which may cause byte adjustments.
It is therefore recommended to add symbolic addresses to the logical address assignment of in- and outputs and to use only these symbolic addresses in the PLC program. (see Figure 6-48: Hardware configuration with symbolic address allocation).

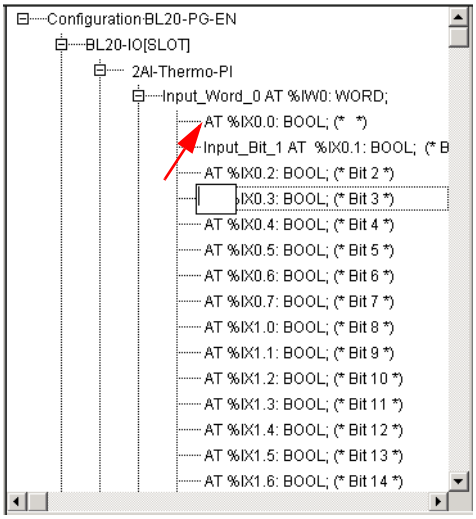
Figure 6-48: Hardware configuration with symbolic address allocation

A *logical address assignment (automatic)*
B *symbolic address assignment (application specific)*



A double click directly to the left of the entry of automatic addressing „AT%...“ opens the input field for the symbolic addressing.

Figure 6-49: Symbolic addressing


Configuration BL20-PG-EN
BL20-IO[SLOT]
2AI-Thermo-PI
Input_Word_0 AT %IW0: WORD;
AT %IX0.0: BOOL; (* *)
Input_Bit_1 AT %IX0.1: BOOL; (* B
AT %IX0.2: BOOL; (* Bit 2 *)
IX0.3: BOOL; (* Bit 3 *)
AT %IX0.4: BOOL; (* Bit 4 *)
AT %IX0.5: BOOL; (* Bit 5 *)
AT %IX0.6: BOOL; (* Bit 6 *)
AT %IX0.7: BOOL; (* Bit 7 *)
AT %IX1.0: BOOL; (* Bit 8 *)
AT %IX1.1: BOOL; (* Bit 9 *)
AT %IX1.2: BOOL; (* Bit 10 *)
AT %IX1.3: BOOL; (* Bit 11 *)
AT %IX1.4: BOOL; (* Bit 12 *)
AT %IX1.5: BOOL; (* Bit 13 *)
AT %IX1.6: BOOL; (* Bit 14 *)

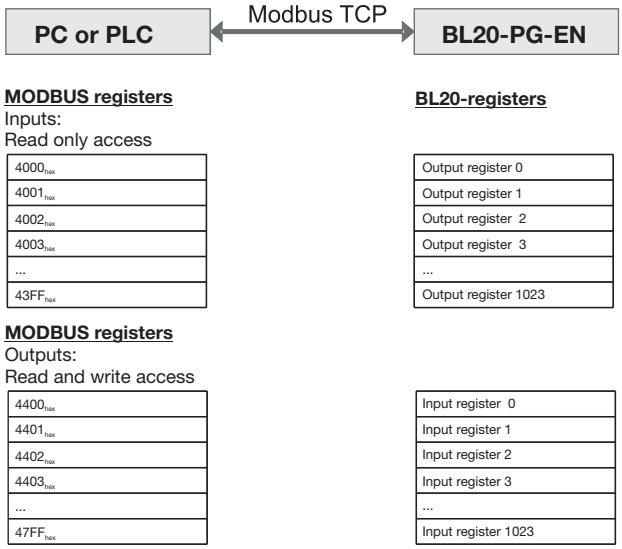
6.5.3 Mapping of the Modbus Registers

In order to enable Modbus communication of BL20-PG-EN with other Modbus nodes, the Modbus registers have to be added to the PLC configuration. (Modbus registers 0×4000 to 0×47FF, page 5-3).

The output data coming from the external Modbus PLC are ampped as input registers in the PG.

The output data from the PG are input data on the PLC side.

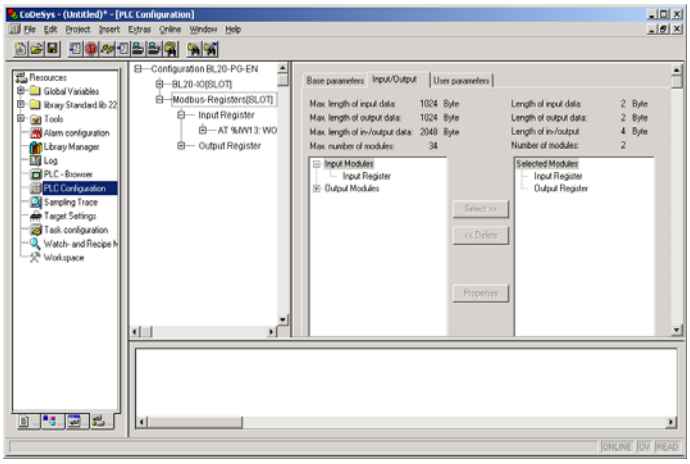
Figure 6-50: Mapping of modbus registers



Add the necessary in- and output registers to the PLC configuration under "Configuration BL20-PG-EN → Modbus-Registers [Slot]".

The in- and output addresses are automatically assigned to the Modbus registers.

Figure 6-51: Configuration of modbus registers



Therefore, a symbolic address allocation is also recommended for the in- and output words of the Modbus registers (see also Note on page 6-13).

Please observe, that Ethernet an the BL20 gateways are Big-Endian-systems (Motorola format).

As shown in the following figure, the high byte of the register is listed first (%IX26 → bit 8 to bit 15), the low byte follows the high byte (%IX27 → bit 0 to bit 7).

The comments (*Bit 0*, *Bit 1* etc.) in the example have been changed according to the application.

Attention

Up to the time of the release of this manual, the automatic allocation of the comments by the software was faulty and did not show the correct bit order.
The CoDeSys-comments always start with *Bit 0* for the first bit of the in- and output words. But, due to the Big-Endian (Motorola format) of the BL20-PG-EN, this is not correct!
The correct data mapping starts with the high byte (bit 8 to bit 15) of the data word, the low byte (bit 0 to bit 7) follows the high byte (see the following figure).

Figure 6-52: Symbolic address allocation of Modbus registers

```
Configuration BL20-PG-EN
  BL20-IO[SLOT]
  Modbus-Registers[SLOT]
    Input Register
      MB_IN_Reg0 AT %IW13: WORD;
        MB_IN_Reg0_Byte1_Bit8 AT %IX26.0: BOOL; (* Bit 8 *)
        MB_IN_Reg0_Byte1_Bit9 AT %IX26.1: BOOL; (* Bit 9 *)
        MB_IN_Reg0_Byte1_Bit10 AT %IX26.2: BOOL; (* Bit 10 *)
        MB_IN_Reg0_Byte1_Bit11 AT %IX26.3: BOOL; (* Bit 11 *)
        MB_IN_Reg0_Byte1_Bit12 AT %IX26.4: BOOL; (* Bit 12 *)
        MB_IN_Reg0_Byte1_Bit13 AT %IX26.5: BOOL; (* Bit 13 *)
        MB_IN_Reg0_Byte1_Bit14 AT %IX26.6: BOOL; (* Bit 14 *)
        MB_IN_Reg0_Byte1_Bit15 AT %IX26.7: BOOL; (* Bit 15 *)
        MB_IN_Reg0_Byte0_Bit0 AT %IX27.0: BOOL; (* Bit 0 *)
        MB_IN_Reg0_Byte0_Bit1 AT %IX27.1: BOOL; (* Bit 1 *)
        MB_IN_Reg0_Byte0_Bit2 AT %IX27.2: BOOL; (* Bit 2 *)
        MB_IN_Reg0_Byte0_Bit3 AT %IX27.3: BOOL; (* Bit 3 *)
```

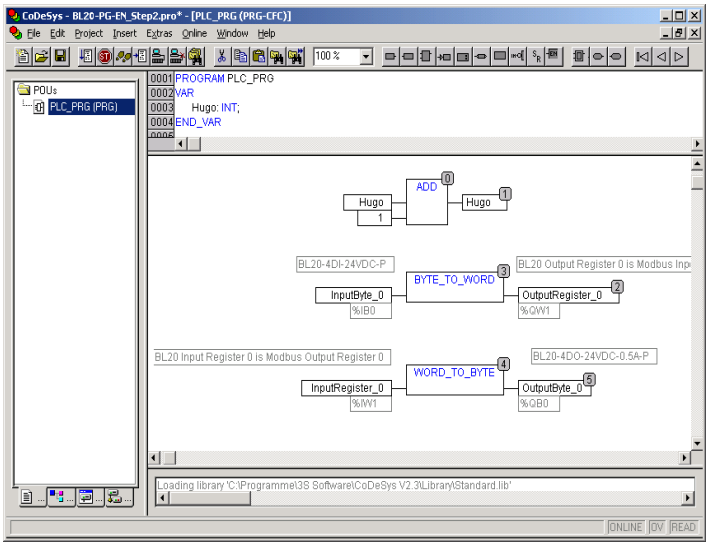
Byte 1

Byte 0

6.6 PLC-Programming

Programming is done in the "POUs" tab.

Figure 6-53: Programming in "POUs" tab

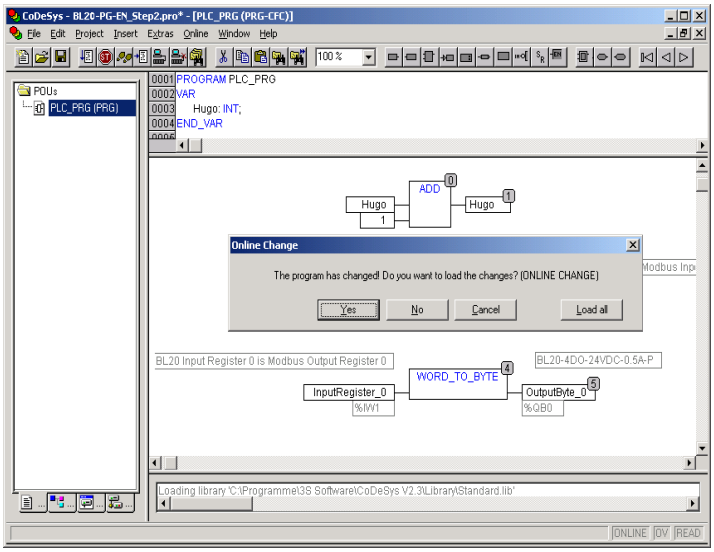


After the completion of the program, it is compiled using the „Project → Rebuild all..." command.

6.6.1 Online

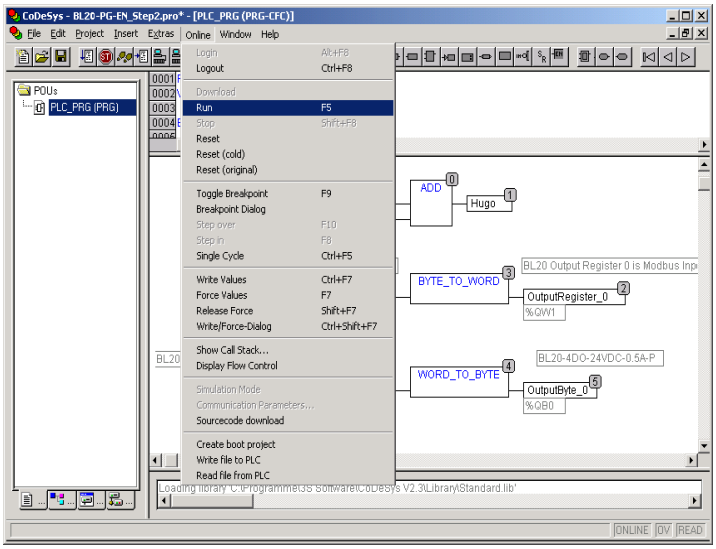
The connection to the gateway is established with "Online → Login".

Figure 6-54: Download of the program



Download the program to the gateway and start it with "Online → Run".

Figure 6-55: Starting the program



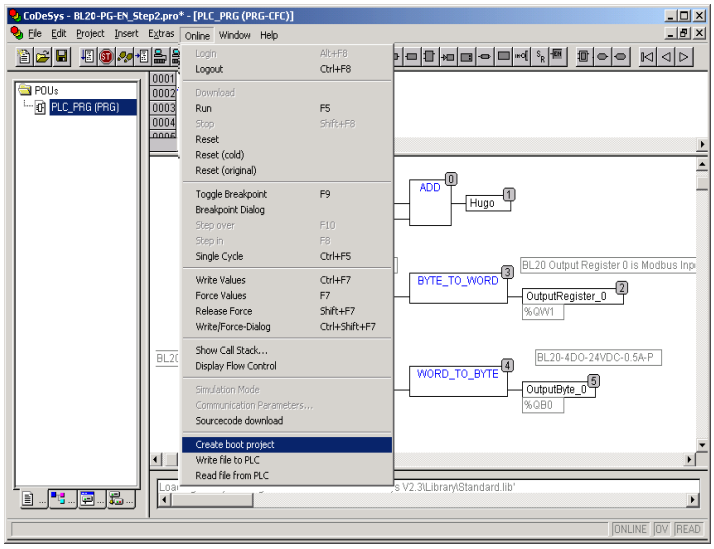
Note

Please observe, projects must be downloaded and saved as boot projects (for further information see the description in the following section Creating a boot project) in order to be stored permanently to the gateway!
All other projects are deleted in case of a boot-up of the gateway!

6.6.2 Creating a boot project

With "Online → create boot project" your program is saved as a boot project which is stored to the BL20-PG-EN and is automatically loaded at every re-start of the gateway.

Figure 6-56: Create boot project



7 Guidelines for Station Planning

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7.1 Random Module Arrangement

The arrangement of the I/O-modules within a BL20 station can basically be chosen at will.

Nevertheless, it can be useful with some applications to group certain modules together.

Attention

Please observe, that RFID modules used within a station always have to be mounted directly following the gateway (slot 1 to 34).

Note

The mixed usage of base modules with screw connections and base modules with tension clamp connections requires a further power supply module to be mounted. Thereby, it must be ensured that the base modules are fitted with the same connection technology (screw or tension clamp) as the power supply module.

7.1.1 Complete Planning

The planning of a BL20 station should be thorough to avoid faults and increase operating reliability.

Attention

If there are more than two empty slots next to one another, the communication is interrupted to all following BL20 modules.

7.1.2 Maximum System Extension

A BL20 station can consist of a gateway and a maximum of 74 modules in slice design (equivalent to 1 m in length of mounting rail including the end bracket and end plate). The maximum number of modules is less when using block modules (1 block module is equivalent to 8 modules in slice design).

The following overview shows the maximum number of channels possible, on condition that the entire station is made up of that respective type of channel only:

Table 7-60: Maximum system extension, process data dependent

A*plus 1*
Bus Refreshing module
B*plus 2*
Bus Refreshing modules
C*plus 3*
Bus Refreshing modules

Channels		**Modules**	
Type	Max. no.	Type	Max. no.
Digital inputs	288	BL20-4DI-24VDC-P	72 **B**
Digital outputs	288	BL20-4DO-24VDC-0.5A-P	72 **B**
Analog inputs, current	126	BL20-2AI-I(0/4...20MA)	63 **C**
Analog inputs, voltage	126	BL20-2AI-U(-10/0...+10VDC)	63 **C**
Analog inputs, PT /Ni	126	BL20-2AI-PT/NI-2/3	63 **C**
Analog inputs, Thermocouple	126	BL20-2AI-THERMO-PI	63 **C**
Analog outputs, current	126	BL20-2AO-I(0/4...20MA)	63 **C**
Analog inputs, voltage	126	BL20-2AO-U(-10/0...+10VDC)	63 **C**
Counter	31	BL20-1CNT-24VDC	31 **A**
RS232	31	BL20-1RS232	31 **A**
RS485/422	31	BL20-1RS485/422	31 **A**
SSI	31	BL20-1SSI	31 **A**

Further limitations can be placed on the maximum possible number of BL20 modules by the use of the Power Feeding modules BL20-PF-24VDC-D or BL20-PF-120/230VAC-D; these being used either for creating potential groups or by insufficient field supply.

Attention

Ensure that a sufficient number of Power Feeding or Bus Refreshing modules are used if the system is extended to its maximum.

Note

If the system limits are exceeded, the software I/O-ASSISTANT generates an error message when the user activates the "Station → Verify" command.

7.2 Power Supply

7.2.1 Module Bus Refreshing

The number of BL20 modules that can be supplied by the gateway or a separate Bus Refreshing module via the internal module bus depends on the respective nominal current consumption of the individual modules on the module bus.

Attention

The sum total of the nominal current consumption of the connected BL20 modules must not exceed 1.5 A.

The following examples show the calculation for the required number of Bus Refreshing modules:

Example 1:

The BL20 station consists of 20 BL20-1AI-I(0/4...20MA) modules. The number of additional Bus Refreshing modules required is calculated as follows:

Gateway		430 mA
20 BL20-1AI-I(0/4...20MA)	20 x 41 mA	820 mA
	Total:	1250 mA
Maximum permissible current via module bus:		1 500 mA

The calculation shows that no further Bus Refreshing module is required.

Example 2:

The BL20 station comprises 15 BL20-1AI-U(-10/0...+10VDC) modules, 10 BL20-2AO-U(-10/0...+10VDC) modules,
10 BL20-2DI-24VDC-P modules and 5 BL20-2DO-24VDC-0.5A-P modules.
The required number of Bus Refreshing modules is calculated as follows:

Gateway		430 mA
15 BL20-1AI-U(-10/0...+10VDC)	15 x 41 mA	615 mA
10 BL20-2AO-U(-10/0...+10VDC)	10 x 43 mA	430 mA
10 BL20-2DI-24VDC-P	10 x 28 mA	280 mA
5 BL20-2DO-24VDC-0.5A-P	5 x 32 mA	160 mA
	Total:	1 915 mA
Maximum permissible current via module bus:		1 500 mA

The calculation shows that an additional/further Bus Refreshing module is required at the latest following the last BL20-2AO module. This Bus Refreshing module is sufficient to supply the remaining modules.

Note

The power requirements of the BL20 gateway is to be considered when calculating the required number of Bus Refreshing modules.

The following table offers an overview of the nominal current consumption of the individual BL20 modules on the module bus:

Table 7-61: Nominal current consumption of the BL20 modules on the module bus

Module	Supply	Nominal current consumption
Gateway	1 500 mA	430 mA
BL20-PF-24VDC-D		28 mA
BL20-PF-120/230VAC-D		25 mA
BL20-2DI-24VDC-P		28 mA
BL20-2DI-24VDC-N		28 mA
BL20-2DI-120/230VAC		28 mA
BL20-4DI-24VDC-P		29 mA
BL20-4DI-24VDC-N		28 mA
BL20-E-8DI-24VDC-P		15 mA
BL20-16DI-24VDC-P		45 mA
BL20-E-16DI-24VDC-P		15 mA
BL20-32DI-24VDC-P		30 mA
BL20-1AI-I(0/4...20MA)		41 mA
BL20-2AI-I(0/4...20MA)		35 mA
BL20-1AI-U(-10/0...+10VDC)		41 mA
BL20-2AI-U(-10/0...+10VDC)		35 mA
BL20-2AI-PT/NI-2/3		45 mA
BL20-2AI-THERMO-PI		45 mA
BL20-4AI-U/I		50 mA
BL20-2DO-24VDC-0.5A-P		32 mA
BL20-2DO-24VDC-0.5A-N		32 mA
BL20-2DO-24VDC-2A-P		33 mA

Table 7-61: Nominal current consumption of the BL20 modules on the module bus

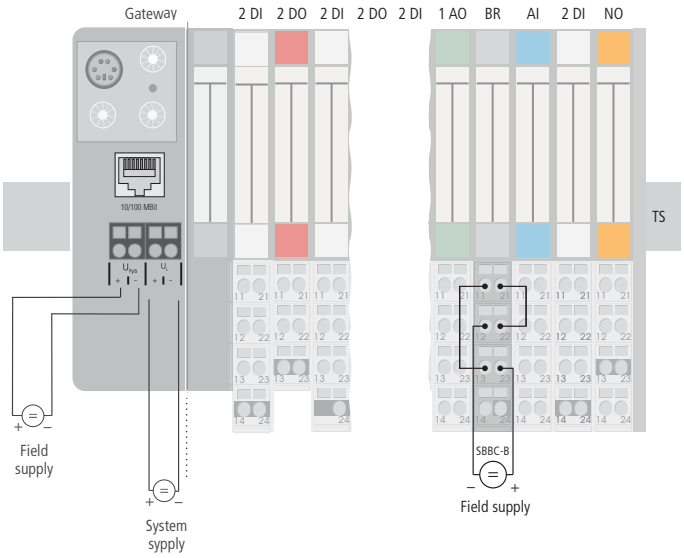
Module	Supply	Nominal current consumption
BL20-4DO-24VDC-0.5A-P		30 mA
BL20-E-8DO-24VDC-P		15 mA
BL20-16DO-24VDC-0.5A-P		120 mA
BL20-E-16DO-24VDC-P		25 mA
BL20-32DO-24VDC-0.5A-P		30 mA
BL20-1AO-I(0/4...20MA)		39 mA
BL20-2AO-I(0/4...20MA)		40 mA
BL20-2AO-U(-10/0...+10VDC)		43 mA
BL20-2DO-R-NC		28 mA
BL20-2DO-R-NO		28 mA
BL20-2DO-R-CO		28 mA
BL20-1CNT-24VDC		40 mA
BL20-1RS232		140 mA
BL20-1RS485/422		60 mA
BL20-1SSI		50 mA
BL20-2RFID		30 mA
BL20-E-1SWIRE		60 mA

If the power supply from the module bus is not guaranteed, thereby making a further Bus Refreshing module necessary, the software I/O-ASSISTANT generates an error message when the user activates the command “Station → Verify“.

Note

Bus Refreshing modules which do not supply the gateway with power are to be combined with either a BL20-P3T-SBB-B or a BL20-P4T-SBBC-B (tension clamp connection) base module or with the base modules BL20-P3S-SBB-B or BL20-P4S-SBBC-B (screw connection).

Figure 7-57: Power supply of the station



It must be ensured that the same ground potential and ground connections are used. If different ground potentials or ground connections are used, compensating currents flow via the module bus, which can lead to the destruction of the Bus Refreshing module.

All Bus Refreshing modules are connected to one another via the same ground potential.

The power to the module bus is supplied via the connections 11 and 21 on the base module.

Attention

In order to comply with radiation limit values in accordance with EN 55 011/ 2 000, the supply lines of the BL20-BR-24VDC-D module for supplying the gateway with power are to be fed through a ferrite ring (PS416-ZBX-405). This is to be placed immediately next to the connection terminals. From there on, it is not permitted to make connections to further devices.

7.2.2 Creating Potential Groups

Bus Refreshing and Power Feeding modules can be used to create potential groups. The potential isolation of potential groups to the left of the respective power distribution modules is provided by the base modules.

Attention

Ensure that the correct base modules are planned for when using Bus Refreshing modules.

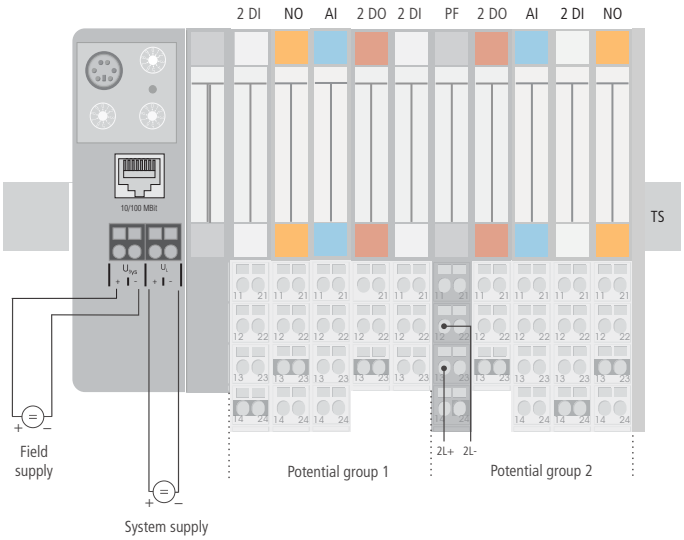


Figure 7-58: Example for creating potential groups

Note

The system can be supplied with power independent of the potential group formation described above.

When using a digital input module for 120/230 V AC, it should be ensured that a potential group is created in conjunction with the Power Feeding module BL20-PF-120/230VAC-D.

Attention

It is not permitted to use the modules with 24 V DC and 120/230 V AC field supply in a joint potential group.

7.2.3 Protecting the Service Interface on the Gateway

During operation, the cover protecting the service interface and the hexadecimal rotary coding-switches must remain closed due to EMC and ESD.

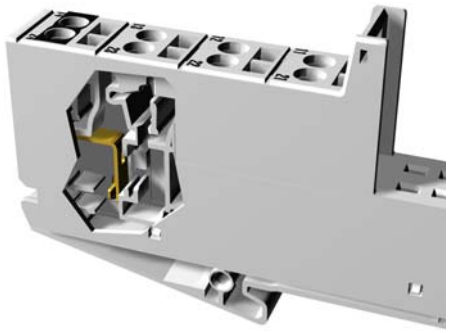
7.2.4 C-Rail (Cross Connection)

The C-rail runs through all base modules. The C-rail of the base modules for power distribution modules is mechanically separated; thus potentially isolating the adjoining supply groups.

Access to the C-rail is possible with the help of base modules with a C in their designation (for example, BL20-S4T-SBCS). The corresponding connection level is indicated on these modules by a thick black line. The black line is continuous on all I/O modules. On power distribution modules, the black line is only above the connection 24. This makes clear that the C-rail is separated from the adjoining potential group to its left.

Figure 7-59: C-rail front view

Figure 7-60: C-rail side view



Danger

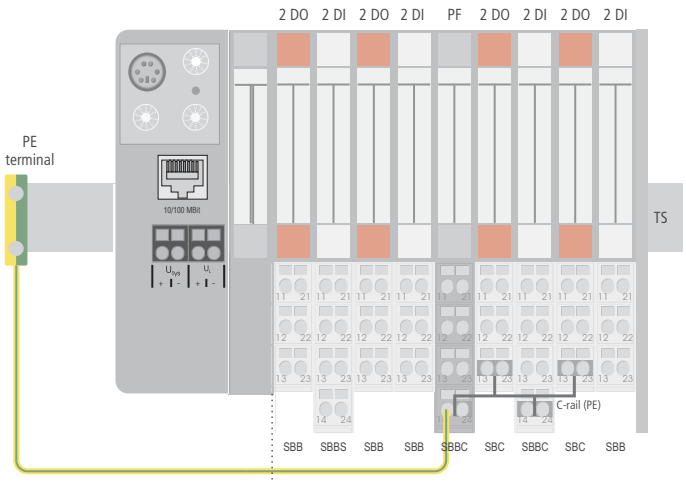
It is permitted to load the C-rail with a maximum of 24 V. Not 230 V!

The C-rail can be used as required by the application, for example, as a protective earth (PE). In this case, the PE connection of each power distribution module must be connected to the mounting rail via an additional PE terminal, which is available as an accessory.

Note

For information about introducing a BL20 station into a ground reference system, please read chapter 8.

Figure 7-61: Using the C-rail as a protective earth

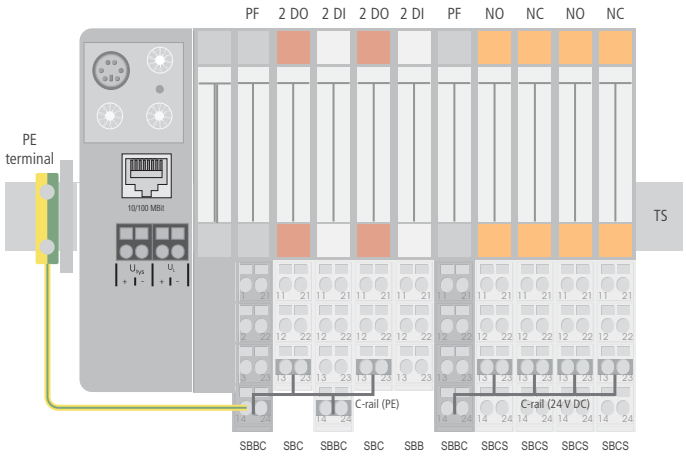


C-rails can be used for a common voltage supply when relay modules are planned. To accomplish this, the load voltage is connected to a Power Feeding module with the BL20-P4x-SBBC base module with tension clamp or screw connection. All the following relay modules are then supplied with power via the C-rail.

Attention

When relay modules are planned and the C-rail is used for a common voltage supply, a further power distribution module must be used for the potential isolation to the following modules. The C-rail can only again be used as a PE following potential isolation.

Figure 7-62: Using the C-rail as protective earth and for the power supply with relay modules



Cross-connecting relay module roots is achieved by the use of jumpers. The corresponding connection diagrams can be found in the manuals for the BL20 I/O modules (German: D300716, English: D300717

7.2.5 Direct Wiring of Relay Modules

As well as the options mentioned above, relay modules can be wired directly. In this case, base modules without C-rail connections should be chosen to guarantee the potential isolation to the adjoining modules.

7.3 Plugging and Pulling Electronics Modules

BL20 enables the pulling and plugging of electronics modules without having to disconnect the field wiring. The BL20 station remains in operation if an electronics module is pulled. The voltage and current supplies as well as the protective earth connections are not interrupted.

Attention

If the field and system supplies remain connected when electronics modules are plugged or pulled, short interruptions to the module bus communications can occur in the BL20 station. This can lead to undefined statuses of individual inputs and outputs of different modules.

7.4 Extending an Existing Station

Attention

Please note that extensions to the station (mounting further modules) should be carried out only when the station is in a voltage-free state.

7.5 Firmware Download

Firmware can be downloaded via the service interface on the gateway using the software tool I/O-ASSISTANT. More information is available in the program's online help.

Attention

The station should be disconnected from the fieldbus when downloading.

Firmware must be downloaded by authorized personnel only.

The field level must be isolated.

8 Guidelines for Electrical Installation

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8.1 General Notes

8.1.1 General

Cables should be grouped together, for example: signal cables, data cables, heavy current cables, power supply cables.

Heavy current cables and signal or data cables should always be routed in separate cable ducts or bundles. Signal and data cables must always be routed as close as possible to ground potential surfaces (for example support bars, cabinet sides etc.).

8.1.2 Cable Routing

Correct cable routing prevents or suppresses the reciprocal influencing of parallel routed cables.

8.1.3 Cable Routing Inside and Outside of Cabinets

To ensure EMC-compatible cable routing, the cables should be grouped as follows:

Various types of cables within the groups can be routed together in bundles or in cable ducts.

Group 1:

- shielded bus and data cables
- shielded analog cables
- unshielded cables for DC voltage ≤ 60 V
- unshielded cables for AC voltage ≤ 25 V

Group 2:

- unshielded cables for DC voltage > 60 V and ≤ 400 V
- unshielded cables for AC voltage > 25 V and ≤ 400 V

Group 3:

- unshielded cables for DC and AC voltages > 400 V

The following group combination can be routed only in separate bundles or separate cable ducts (no minimum distance apart):

- **Group 1/Group 2**

The group combinations:

- **Group 1/Group 3 and Group 2/Group 3**

must be routed in separate cable ducts with a minimum distance of 10 cm apart. This is equally valid for inside buildings as well as for inside and outside of switchgear cabinets.

Cable Routing Outside Buildings

Outside of buildings, cables should be routed in closed (where possible), cage-type cable ducts made of metal. The cable duct joints must be electrically connected and the cable ducts must be earthed.

Danger

Observe all valid guidelines concerning internal and external lightning protection and grounding specifications when routing cables outside of buildings.

8.1.4 Lightning Protection

The cables must be routed in double-grounded metal piping or in reinforced concrete cable ducts.

Signal cables must be protected against overvoltage by varistors or inert-gas filled overvoltage arrestors. Varistors and overvoltage arrestors must be installed at the point where the cables enter the building.

8.1.5 Transmission Media

For a communication via Ethernet, different transmission media can be used:

- coaxial cable
  10Base2 (thin koax),
  10Base5 (thick koax, yellow cable)
- optical fibre (10BaseF)
- twisted two-wire cable (10BaseT) with shielding (STP) or without shielding (UTP).

Note

TURCK offers a variety of cable types for fieldbus lines as premoulded or bulk cables with different connectors.
The ordering information for the available cable types can be found in the BL20 catalog.

8.2 Potential Relationships

8.2.1 General

The potential relationship of a Ethernet system realized with BL20 modules is characterized by the following:

- The system supply of gateway and I/O-modules as well as the field supply are realized via one power feed at the gateway.
- All BL20 modules (gateway, Power Feeding and I/O-modules), are connected capacitively via base modules to the mounting rails.

The block diagram shows the arrangement of a typical BL20 station.

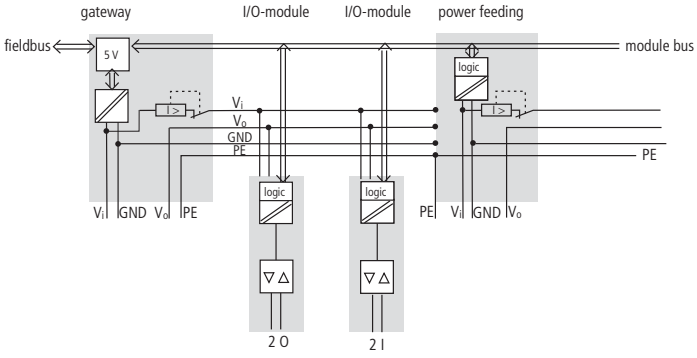

Figure 8-63: Block diagram of a BL20 station

8.3 Electromagnetic Compatibility (EMC)

BL20 products comply in full with the requirements pertaining to EMC regulations.

Nevertheless, an EMC plan should be made before installation. Hereby, all potential electromechanical sources of interference should be considered such as galvanic, inductive and capacitive couplings as well as radiation couplings.

8.3.1 Ensuring Electromagnetic Compatibility

The EMC of BL20 modules is guaranteed when the following basic rules are adhered to:

- Correct and large surface grounding of inactive metal components.
- Correct shielding of cables and devices.
- Proper cable routing – correct wiring.
- Creation of a standard reference potential and grounding of all electrically operated devices.
- Special EMC measures for special applications.

8.3.2 Grounding of Inactive Metal Components

All inactive metal components (for example: switchgear cabinets, switchgear cabinet doors, supporting bars, mounting plates, tophat rails, etc.) must be connected to one another over a large surface area and with a low impedance (grounding). This guarantees a standardized reference potential area for all control elements and reduces the influence of coupled disturbances.

- In the areas of screw connections, the painted, anodized or isolated metal components must be freed of the isolating layer. Protect the points of contact against rust.
- Connect all free moving groundable components (cabinet doors, separate mounting plates, etc.) by using short bonding straps to large surface areas.
- Avoid the use of aluminum components, as its quick oxidizing properties make it unsuitable for grounding.

Danger

The grounding must never – including cases of error – take on a dangerous touch potential. For this reason, always protect the ground potential with a protective cable.

8.3.3 PE Connection

A central connection must be established between ground and PE connection (protective earth).

8.3.4 Earth-Free Operation

Observe all relevant safety regulations when operating an earthfree system.

8.3.5 Mounting Rails

All mounting rails must be mounted onto the mounting plate with a low impedance, over a large surface area, and must be correctly earthed.

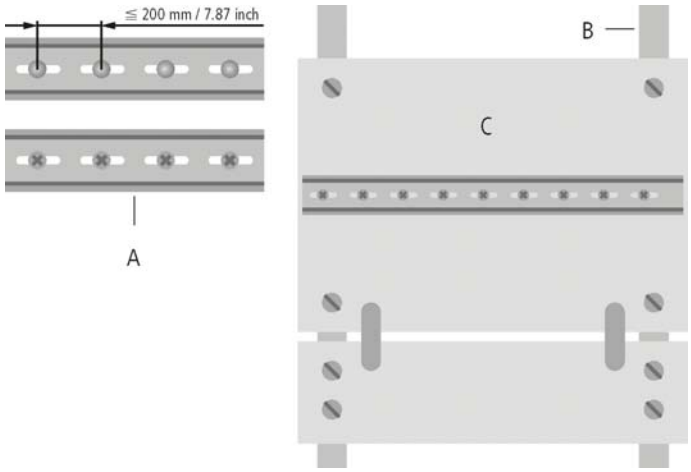

Figure 8-64: Mounting options

A *TS 35*
B *Mounting rail*
C *Mounting plate*

Mount the mounting rails over a large surface area and with a low impedance to the support system using screws or rivets.

Remove the isolating layer from all painted, anodized or isolated metal components at the connection point. Protect the connection point against corrosion (for example with grease; caution: use only suitable grease).

8.4 Shielding of cables

Shielding is used to prevent interference from voltages and the radiation of interference fields by cables. Therefore, use only shielded cables with shielding braids made from good conducting materials (copper or aluminum) with a minimum degree of coverage of 80 %.

The cable shield should always be connected to both sides of the respective reference potential (if no exception is made, for example, such as high-resistant, symmetrical, analog signal cables). Only then can the cable shield attain the best results possible against electrical and magnetic fields.

A one-sided shield connection merely achieves an isolation against electrical fields.

Attention

When installing, please pay attention to the following...

– the shield should be connected immediately when entering the
– system,
– the shield connection to the shield rail should be of low
– impedance,
– the stripped cable-ends are to be kept as short as possible,
– the cable shield is not to be used as a bonding conductor.

If the data cable is connected via a SUB-D connector, the shielding should never be connected via pin 1, but to the mass collar of the plug-in connector.

The insulation of the shielded data-cable should be stripped and connected to the shield rail when the system is not in operation. The connection and securing of the shield should be made using metal shield clamps. The shield clamps must enclose the shielding braid and in so doing create a large surface contact area. The shield rail must have a low impedance (for example, fixing points of 10 to 20 cm apart) and be connected to a reference potential area.

The cable shield should not be severed, but routed further within the system (for example, to the switchgear cabinet), right up to the interface connection.

Note

Should it not be possible to ground the shield on both sides due to switching arrangements or device specific reasons, then it is possible to route the second cable shield side to the local reference potential via a capacitor (short connection distances). If necessary, a varistor or resistor can be connected parallel to the capacitor, to prevent disruptive discharges when interference pulses occur.

A further possibility is a double-shielded cable (galvanically separated), whereby the innermost shield is connected on one side and the outermost shield is connected on both sides.

8.5 Potential Compensation

Potential differences can occur between installation components that are in separate areas and these

- are fed by different supplies,
- have double-sided conductor shields which are grounded on different installation components.

A potential-compensation cable must be routed to the potential compensation.

Danger

Never use the shield as a potential compensation.

A potential compensation cable must have the following characteristics:

- Low impedance. In the case of compensation cables that are routed on both sides, the compensation line impedance must be considerably smaller than that of the shield connection (max. 10 % of shield connection impedance).
- Should the length of the compensation cable be less than 200 m, then its cross-section must be at least 16 mm^2 / 0.025 $inch^2$. If the cable length is greater than 200 m, then a cross-section of at least 25 mm^2 / 0.039 $inch^2$ is required.
- The compensation cable must be made of copper or zinc coated steel.
- The compensation cable must be connected to the protective conductor over a large surface area and must be protected against corrosion.
- Compensation cables and data cables should be routed as close together as possible, meaning the enclosed area should be kept as small as possible.

8.5.1 Switching Inductive Loads

In the case of inductive loads, a protective circuit on the load is recommended.

8.5.2 Protection against Electrostatic Discharge (ESD

Attention

Electronic modules and base modules are at risk from electrostatic discharge when disassembled. Avoid touching the bus connections with bare fingers as this can lead to ESD damage.

9 BL20-Approvals for Zone 2/ Division 2

Note

The Zone 2 - approval certificates for BL20 can be found in a separate manual for approvals D301255 on www.turck.de.

10 Appendix

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– Changing the IP address in Windows NT 3
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10.1 Network Configuration

Note

In order to build up the communication between the BL20-gateway and a PLC/ PC or a network interface card, both devices have to be hosts in the same network.

The network is already defined by the default-settings in the BL20-gateways.

The default IP address for the BL20-gateways is 192.168.1.1 (see also chapter 3, page 3-2, section IP address).

If necessary, please adjust the IP address of the PLC/ PC or the network interface card.

10.1.1 Changing the IP address of a PC/ network interface card

Changing the IP address in Windows 2000/ Windows XP

The IP address is changed in the "Control Panel" in "Network and Dial-up Connections":

1. Open the folder "Local Area Connection" and open the dialog "Local Area Connection Properties" via the button "Properties" in the dialog "Local Area Connection Status".
2. Mark "Internet Protocol (TCP/IP)" and press the "Properties"-button to open the dialog "Internet Protocol (TCP/IP) Properties".

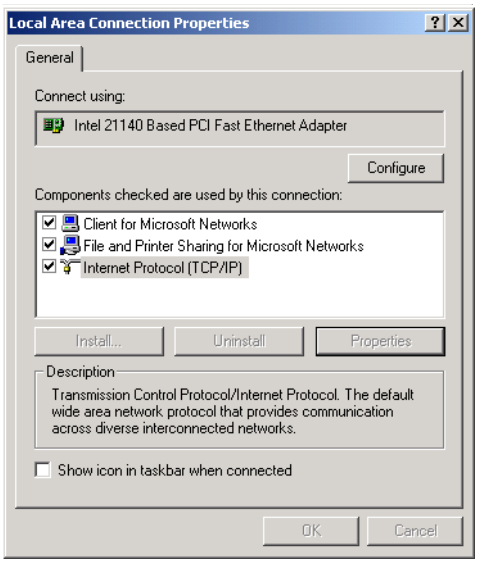
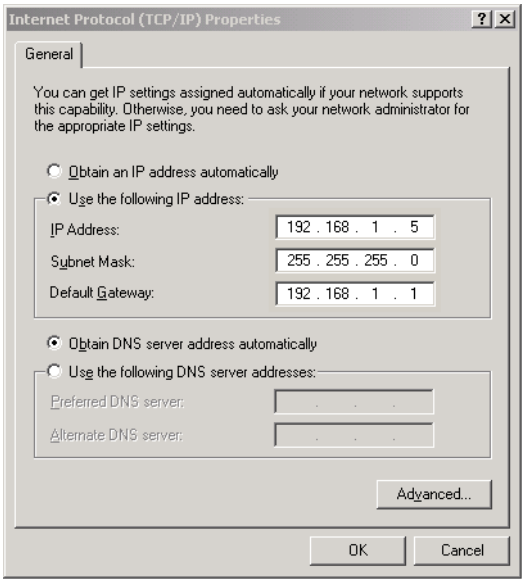


Figure 10-65: Local Area Connection Properties

3 Activate "Use the following IP address" and assign an IP address of the network mentioned above to the PC/ Network interface card (see the following figure).

Figure 10-66: Changing the PC's IP address

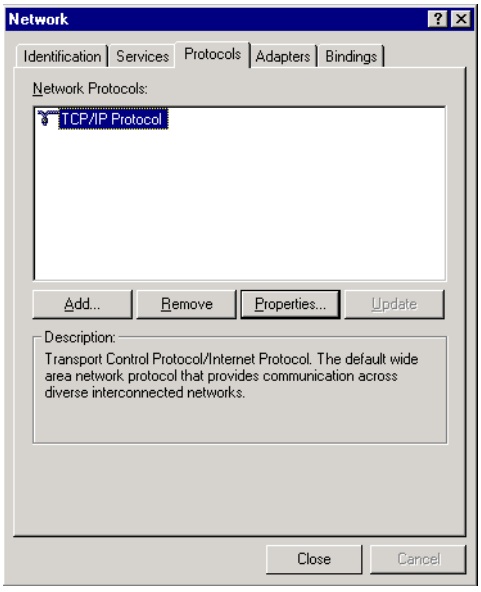

Internet Protocol (TCP/IP) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP Address:
192 . 168 . 1 . 5
Subnet Mask:
255 . 255 . 255 . 0
Default Gateway:
192 . 168 . 1 . 1
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Advanced...
OK
Cancel

Changing the IP address in Windows NT

1 Open the folder "Network" in the Control Panel.

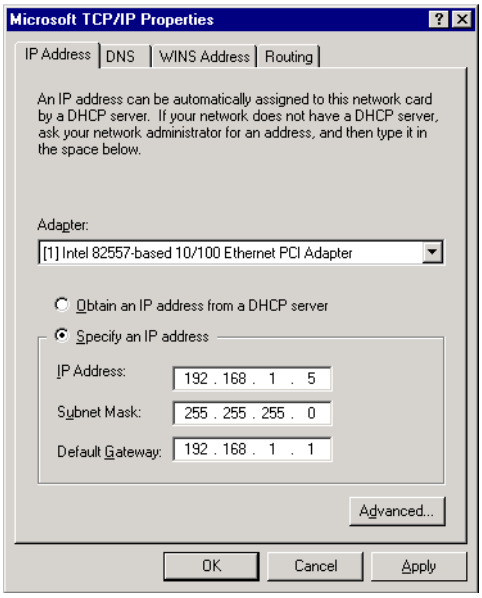
2 Activate TCP/IP connection in the tab "Protocols" and click the "Properties" button.

Figure 10-67: Network configuration WIN NT



3 Activate "Specify IP address " and set the address as follows.

Figure 10-68: Specify IP address


Microsoft TCP/IP Properties
IP Address
DNS
WINS Address
Routing
An IP address can be automatically assigned to this network card by a DHCP server. If your network does not have a DHCP server, ask your network administrator for an address, and then type it in the space below.
Adapter:
[1] Intel 82557-based 10/100 Ethernet PCI Adapter
Obtain an IP address from a DHCP server
Specify an IP address
IP Address:
192 . 168 . 1 . 5
Subnet Mask:
255 . 255 . 255 . 0
Default Gateway:
192 . 168 . 1 . 1
Advanced...
OK
Cancel
Apply

Changing the IP address via I/O-ASSISTANT

The Address Tool integrated in the I/O-ASSISTANT offers the possibility to browse the whole Ethernet network for connected nodes and to change their IP address as well as the subnet mask according to the application (for further information, please read Address-setting via I/O-ASSISTANT 3 (FDT/DTM) (page 4-15).

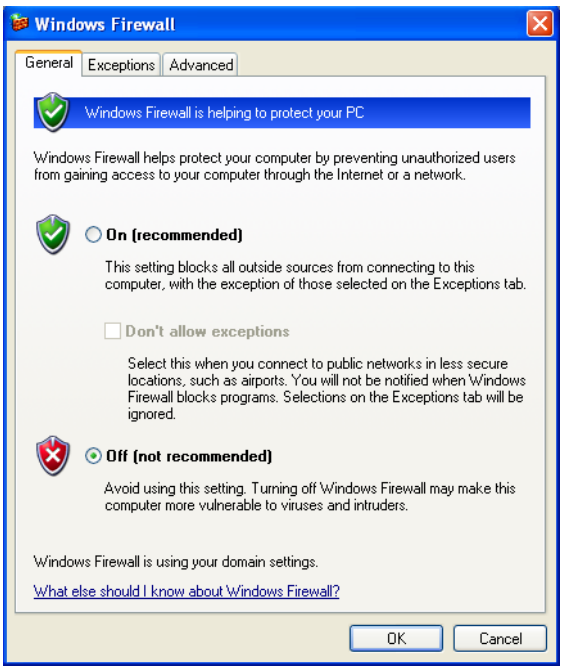
10.1.2 Deactivating/ adapting the firewall in Windows XP

If Windows XP is used as operating system, problems with the system-integrated firewall may occur in case of an access of outside sources to your computer or in case of tools like the I/O-ASSISTANT which are used for changing the IP address of the gateways.

In this case, you can deactivate the system integrated Windows XP firewall completely or adapt it to your application.

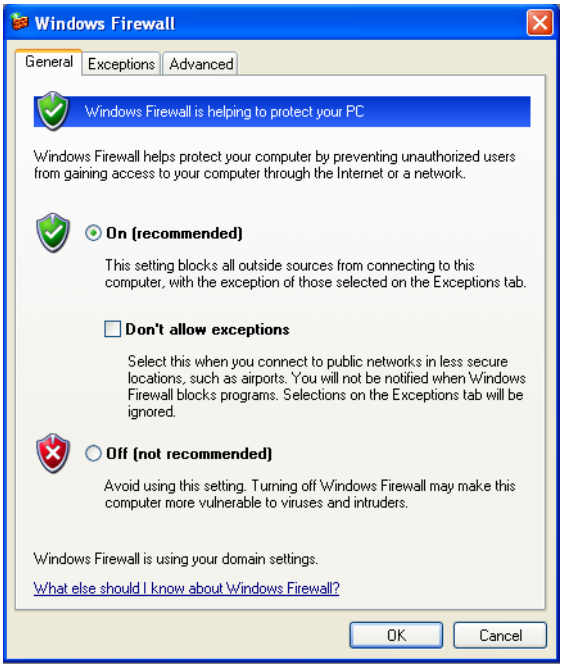
- **Deactivating the firewall**
  Open the "Windows Firewall" dialog in the control panel of your PC and deactivate it as follows:

Figure 10-69: Deactivating the Windows firewall


Windows Firewall
General
Exceptions
Advanced
Windows Firewall is helping to protect your PC
Windows Firewall helps protect your computer by preventing unauthorized users from gaining access to your computer through the Internet or a network.
On (recommended)
This setting blocks all outside sources from connecting to this computer, with the exception of those selected on the Exceptions tab.
Don't allow exceptions
Select this when you connect to public networks in less secure locations, such as airports. You will not be notified when Windows Firewall blocks programs. Selections on the Exceptions tab will be ignored.
Off (not recommended)
Avoid using this setting. Turning off Windows Firewall may make this computer more vulnerable to viruses and intruders.
Windows Firewall is using your domain settings.
What else should I know about Windows Firewall?
OK
Cancel

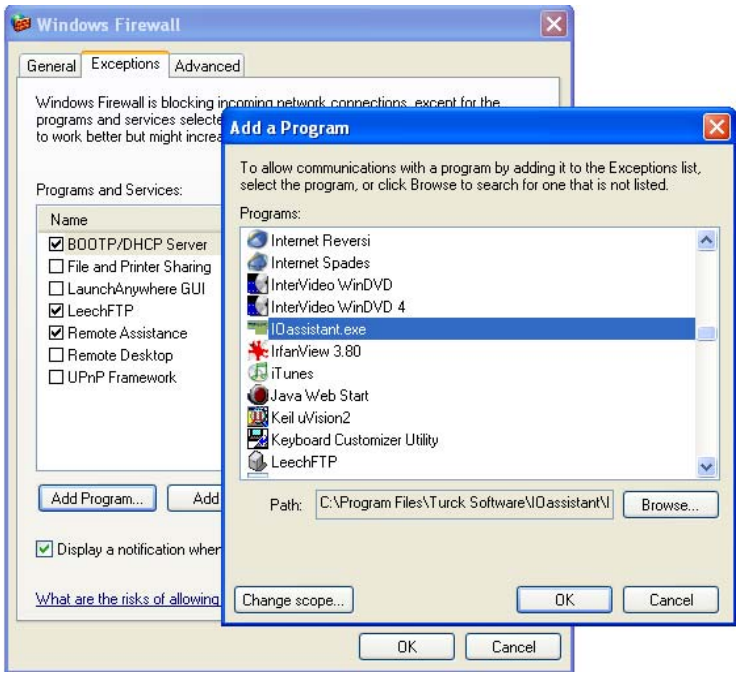
- **Adapting the firewall**
  The firewall remains active, the option "Don't allow exceptions" it deactivated:

Figure 10-70: Activating the Windows firewall


Windows Firewall
General
Exceptions
Advanced
Windows Firewall is helping to protect your PC
Windows Firewall helps protect your computer by preventing unauthorized users from gaining access to your computer through the Internet or a network.
On (recommended)
This setting blocks all outside sources from connecting to this computer, with the exception of those selected on the Exceptions tab.
Don't allow exceptions
Select this when you connect to public networks in less secure locations, such as airports. You will not be notified when Windows Firewall blocks programs. Selections on the Exceptions tab will be ignored.
Off (not recommended)
Avoid using this setting. Turning off Windows Firewall may make this computer more vulnerable to viruses and intruders.
Windows Firewall is using your domain settings.
What else should I know about Windows Firewall?
OK
Cancel

- In the "Exceptions"-tab, add the programs or services for which you want to allow the access to your computer.

Figure 10-71: "Exceptions"-tab



Note

Despite an active firewall, the I/O-ASSISTANT for example is now able to browse the network for hosts and the address changing via the software is possible for the connected nodes.

11 Glossary

A

Acknowledge

Acknowledgment of a signal received.

Active metal component

Conductor or conducting component that is electrically live during operation.

Address

Identification number of, e.g. a memory position, a system or a module within a network.

Addressing

Allocation or setting of an address, e. g. for a module in a network.

ARP

Used to definitely allocate the hardware addresses (MAC-IDs) assigned worldwide to the IP addresses of the network clients via internal tables.

Analog

Infinitely variable value, e. g. voltage. The value of an analog signal can take on any value, within certain limits.

Automation device

A device connected to a technical process with inputs and outputs for control. Programmable logic controllers (PLC) are a special group of automation devices.

B

Baud

Baud is a measure for the transmission speed of data. 1 Baud corresponds to the transmission of one bit per second (bit/s).

Baud rate

Unit of measurement for measuring data transmission speeds in bit/s.

Bidirectional

Working in both directions.

Bonding strap

Flexible conductor, normally braided, that joins inactive components, e. g. the door of a switchgear cabinet to the cabinet main body.

Bus

Bus system for data exchange, e. g. between CPU, memory and I/O levels. A bus can consist of several parallel cables for data transmission, addressing, control and power supply.

Bus cycle time

Time required for a master to serve all slaves or stations in a bus system, i. e. reading inputs and writing outputs.

Bus line

Smallest unit connected to a bus, consisting of a PLC, a coupling element for modules on the bus and a module.

Bus system

All units which communicate with one another via a bus.

C

Capacitive coupling

Electrical capacitive couplings occur between cables with different potentials. Typical sources of interference are, for example, parallel-routed signal cables, contactors and electrostatic discharges.

Check-back interface

The check-back interface is the interface from the counter module to the internal module bus. The bits and bytes are converted by the gateway from the respective type of communication applicable to the fieldbus in to the module-specific bits and bytes.

Coding elements

Two-piece element for the unambiguous assignment of electronic and base modules.

Configuration

Systematic arrangement of the I/O-modules of a station.

Control interface

The control interface is the interface from the internal module bus to the counter module. The commands and signals directed to the counter module are converted by the gateway from the respective type of communication applicable to the fieldbus in to the module-specific bits and bytes.

CPU

Central Processing Unit. Central unit for electronic data processing, the processing core of the PC.

D

DHCP

Client-Server-protocol which reduces the effort of assigning IP addresses or other parameters. Serves for dynamic and automatic configuration of devices.

Digital

A value (e. g. a voltage) which can adopt only certain statuses within a finite set, mostly defined as 0 and 1.

DIN

German acronym for German Industrial Standard.

E

EIA

Electronic Industries Association – association of electrical companies in the United States.

Electrical components

All objects that produce, convert, transmit, distribute or utilize electrical power (e. g. conductors, cable, machines, control devices).

EMC

Electromagnetic compatibility – the ability of an electrical part to operate in a specific environment without fault and without exerting a negative influence on its environment.

EN

German acronym for European Standard.

ESD

Electrostatic Discharge.

F

Field power supply

Voltage supply for devices in the field as well as the signal voltage.

Fieldbus

Data network on sensor/actuator level. A fieldbus connects the equipment on the field level. Characteristics of a fieldbus are a high transmission security and real-time behavior.

Force Mode

Software mode which enables the user to set his plant to a required state by forcing certain variables on the input and output modules.

G

GND

Abbreviation of ground (potential "0").

Ground

Expression used in electrical engineering to describe an area whose electrical potential is equal to zero at any given point. In neutral grounding devices, the potential is not necessarily zero, and one speaks of the ground reference.

Ground connection

One or more components that have a good and direct contact to earth.

Ground reference

Potential of ground in a neutral grounding device. Unlike earth whose potential is always zero, it may have a potential other than zero.

H

Hexadecimal

System of representing numbers in base 16 with the digits 0... 9, and further with the letters A, B, C, D, E and F.

Hysteresis

A sensor can get caught up at a certain point, and then "waver" at this position. This condition results in the counter content fluctuating around a given value. Should a reference value be within this fluctuating range, then the relevant output would be turned on and off in rhythm with the fluctuating signal.

I

I/O

Input/output.

Impedance

Total effective resistance that a component or circuit has for an alternating current at a specific frequency.

Inactive metal components

Conductive components that cannot be touched and are electrically isolated from active metal components by insulation, but can adopt voltage in the event of a fault.

Inductive coupling

Magnetic inductive couplings occur between two cables through which an electrical current is flowing. The magnetic effect caused by the electrical currents induces an interference voltage. Typical sources of interference are for example, transformers, motors, parallel-routed network and HF signal cables.

Intelligent modules

Intelligent modules are modules with an internal memory, able to transmit certain commands (e. g. substitute values and others).

IP

Abbreviation for Internet-Protocol, protocol for the packet-oriented and connectionless transport of data packets from a transmitter to a receiver crossing different networks.

L

Lightning protection

All measures taken to protect a system from damage due to overvoltages caused by lightning strike.

Low impedance connection

Connection with a low AC impedance.

LSB

Least Significant bit

M

Mass

All interconnected inactive components that do not take on a dangerous touch potential in the case of a fault.

Master

Station in a bus system that controls the communication between the other stations.

Modbus TCP

The Modbus protocol is part of the TCP/IP protocol.

The communication is realized via function codes, which are implemented into the data telegram. Modbus TCP uses the Transport Control Protocol (TCP) for the transmission of the Modbus user protocol in Ethernet-TCP-IP networks.

Module bus

The module bus is the internal bus in a station. The modules communicate with the gateway via the module bus which is independent of the fieldbus.

MSB

Most Significant bit

P

Ping

Implementation of an echo-protocol, used for testing whether a particular host is operating properly and is reachable on the network from the testing host.

PLC

Programmable Logic Controller.

Potential compensation

The alignment of electrical levels of electrical components and external conductive components by means of an electrical connection.

Potential free

Galvanic isolation of the reference potentials in I/O-modules of the control and load circuits.

Potential linked

Electrical connection of the reference potentials in I/O-modules of the control and load circuits.

Protective earth

Electrical conductor for protection against dangerous shock currents. Generally represented by PE (protective earth).

R

Radiation coupling

A radiation coupling appears when an electromagnetic wave hits a conductive structure. Voltages and currents are induced by the collision. Typical sources of interference are for example, sparking gaps (spark plugs, commutators from electric motors) and transmitters (e. g. radio), that are operated near to conducting structures.

Reaction time

The time required in a bus system between a reading operation being sent and the receipt of an answer. It is the time required by an input module to change a signal at its input until the signal is sent to the bus system.

Reference potential

Potential from which all voltages of connected circuits are viewed and/or measured.

Repeater

Amplifier for signals transmitted via a bus.

Root-connecting

Creating a new potential group using a power distribution module. This allows sensors and loads to be supplied individually.

RS 485

Serial interface in accordance with EIA standards, for fast data transmission via multiple transmitters.

S

Serial

Type of information transmission, by which data is transmitted bit by bit via a cable.

Setting parameters

Setting parameters of individual stations on the bus and their modules in the configuration software of the master.

Shield

Conductive screen of cables, enclosures and cabinets.

Shielding

Description of all measures and devices used to join installation components to the shield.

Short-circuit proof

Characteristic of electrical components. A short-circuit proof part withstands thermal and dynamic loads which can occur at its place of installation due to a short circuit.

Station

A functional unit or I/O components consisting of a number of elements.

T

TCP

Abbreviation for Transmission Control Protocol, connection-oriented transport protocol within the Internet protocol suite. Certain error detection mechanisms (i.e. acknowledgements, time-out monitoring) can guarantee a safe and error free data transport.

Terminating resistance

Resistor on both ends of a bus cable used to prevent interfering signal reflections and which provides bus cable matching. Terminating resistors must always be the last component at the end of a bus segment.

To ground

Connection of a conductive component with the grounding connection via a grounding installation.

Topology

Geometrical structure of a network or the circuitry arrangement.

U

UDP

Abbreviation for User Datagram Protocol. UDP is an transport protocol for the connectionless data between Ethernet hosts.

Unidirectional

Working in one direction.

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